HETCH HETCHY

Its Origin and History

M. M. O'SHAUGHNESSY

1/1000 c

— Daughter?

Mary O'Shaughnessy

— R.R. Historian (ex Hotel Hotel ???)

To Ted Wurm

From

Helen O'Shaughnessy

and Bess O'Shaughnessy

December 12, 1965.

HETCH HETCHY

Its Origin and History

By M. M. O'Shaughnessy

ISSUED IN LIMITED EDITION ONLY

For Sale By

John J. Newbegin

358 Post Street San Francisco

and at All Book Stores

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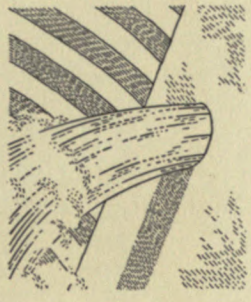
ITS ORIGIN AND HISTORY

O'SHAUGHNESSY DAM
1923

HETCH HETCHY

Its Origin and History



M. M. O'SHAUGHNESSY

Consulting Engineer, San Francisco

Bachelor of Engineering, Royal University, Dublin, 1884
Member, American Society of Civil Engineers, 1902
Member, New England Water Works Association, 1907
Member, American Water Works Association, 1907
Doctor of Science, University of San Francisco, 1930

SAN FRANCISCO, CALIFORNIA
NINETEEN HUNDRED THIRTY-FOUR

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FOREWORD

The last of the aqueduct between Mitchell and Mocho shafts has been finished and water has been flowing from the Sierra Nevada Mountains into Crystal Springs Lake since the 7th of October, 1934.

I was appointed City Engineer September 1, 1912, by James Rolph, Jr., the then Mayor, and served in that capacity during the period of his occupancy. My position and that of the Board of Public Works was abolished by the new Charter and on February 8, 1932, the present Public Utilities Commission appointed me as Consulting Engineer on the completion of Hetch Hetchy.

Forty years ago my first public experience for San Francisco was in projecting new streets such as Market Street over Twin Peaks and via Sloat Boulevard to the ocean, and the extension of Potrero Avenue northerly and southerly to the County Line, coinciding practically with the existing Bay Shore Highway, so that it was with some hesitancy I again entered the City's service.

All my other experience has been with Public Service corporations, such as the sugar plantations of Hawaii, where I served as Chief Engineer in building three large aqueducts from 1900 to 1906, and from 1907 to 1912 as Chief Engineer of the Southern California Mountain Water Company, San Diego, working directly under two old San Franciscans—Mr. John D. Spreckels and Mr. A. B. Spreckels.

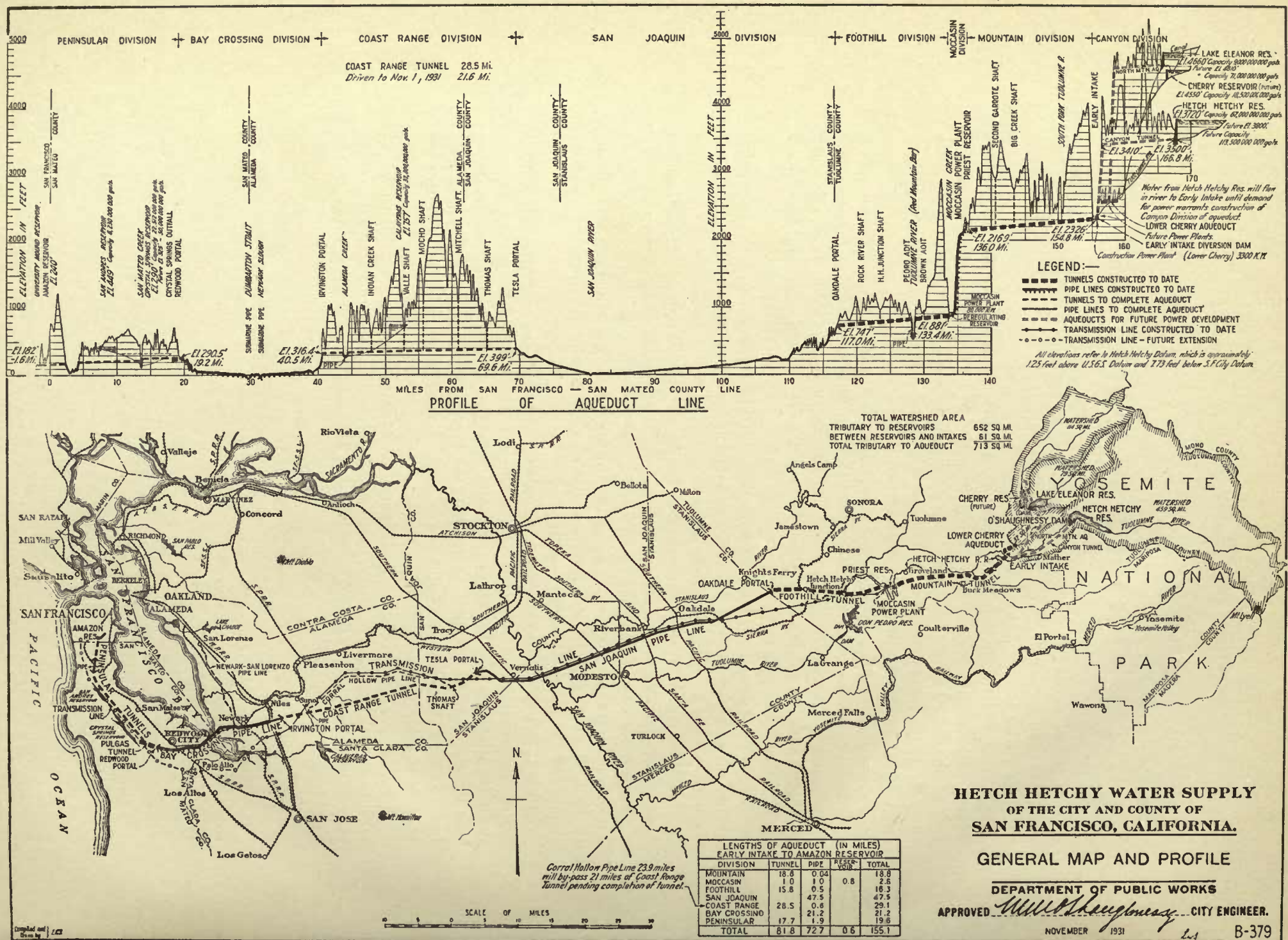
San Francisco was engaged in the midst of a controversy in obtaining rights on Hetch Hetchy, and all those matters are recited in this book from my actual contact with the subjects. I never handled any proposition where the engineering problems were so simple and the political ones so complex.

I am very happy that the work is completed, at relatively moderate costs. This is due to the efficient camp and labor conditions I established and the good order and discipline which prevailed in all of our camps. One may forget the minor controversies that developed on the project. They have no bearing on its historical character and hence I confine my discussion to major problems. It is a great undertaking that has been brought to completion.

I want to pay tribute and acknowledgment to the late Hon. James D. Phelan, whose services and sympathy were always at my command, and to the men I selected to assist me on the work who as faithful citizens of San Francisco all gave the best that was in them toward the enterprise.

M. M. O'Shaughnessy

M. M. O'Shaughnessy was for twenty years the Chief of the City's Engineering Department; and for the past two and one-half years Consulting Engineer of San Francisco's Public Utilities Commission.



LENGTHS OF AQUEDUCT (IN MILES) EARLY INTAKE TO AMAZON RESERVOIR

DIVISION	TUNNEL	PIPE	RESERVOIR	TOTAL
MOUNTAIN	18.8	0.04		18.8
MOCCASIN	1.0	1.0	0.8	2.8
FOOTHILL	15.8	0.5		16.3
SAN JOAQUIN		47.5		47.5
COAST RANGE	28.5	0.6		29.1
BAY CROSSING		21.2		21.2
PENINSULAR	17.7	1.9		19.6
TOTAL	81.8	72.7	0.6	155.1

HETCH HETCHY WATER SUPPLY
OF THE CITY AND COUNTY OF
SAN FRANCISCO, CALIFORNIA.

GENERAL MAP AND PROFILE

DEPARTMENT OF PUBLIC WORKS

APPROVED _____ CITY ENGINEER.

NOVEMBER 1931

B-379

HETCH HETCHY—ITS ORIGIN AND HISTORY

CHAPTER I

M. M. O'Shaughnessy Employed as City Engineer

IN THE latter part of August, 1912, Mayor Rolph wired me at San Diego, when as Chief Engineer of the Southern California Mountain Water Company I had completed its system, asking if I would be available for the position of City Engineer of San Francisco, and I answered advising him that I would need at least a week's consideration to arrive at a decision on the subject.

My previous contact, 29 years ago, with public officials in the City of San Francisco had been discouraging. I was authorized by the Democratic Board of Supervisors in 1891 to make surveys for the extension of Market Street over Twin Peaks Mountain to the Pacific Ocean, at an expense of $5,000, and through political juggling got cheated out of the fee for all my work. I had a subsequent experience in 1892 with a succeeding Republican Board of Supervisors—the Taber Board—which retained me on the extension of the Potrero Avenue for the opening of the so-called Bay Shore Boulevard from Ninth Street to the County Line, and after a legal contest another $5,000 fee for a great volume of engineering work went a-glimmering. Hence my hesitation about having any further business contacts with the new generation of City Officials of San Francisco.

Other incentives, however, induced me to reconsider my attitude. Two thousand three hundred acres of the City had been destroyed by fire in 1906 and 100,000 people deprived of homes. The reconstruction of public utilities was badly needed in this portion of the City and domestic reasons above all, my wife being a native of the City, influenced my decision and favorable consideration of the Mayor's proposal.

On Saturday forenoon, August 31st, 1912, I had my first official interview with the Mayor in his office in the temporary City Hall, now the Whitcomb Hotel building on the south side of Market Street, in which, after discussion, he agreed to select me for City Engineer at a salary of $15,000 annually. This to me was then a financial sacrifice, as my engineering fees the previous year exceeded $30,000. He gave out the following interview on the result to the press:

> The matter of the selection of a City Engineer succeeding Mr. Marsden Manson has given me great concern, because the City Engineer will have to plan, initiate, and accomplish during the next three years work of the very greatest extent and importance.
>
> Until the organization of a Metropolitan Water Board is completed, he must carry out the preliminaries of the Freeman plans in bringing the Hetch Hetchy water to our City and this will include undertaking the construction of immense dams, tunnels and pipe lines. In short, he must

organize the construction and administration of a water system which will involve the economical and efficient expenditure of approximately $40,000,000.

In addition to this system, if the City purchases the Spring Valley Water Works he will take charge of the Engineering Department of that system and carry to completion the development of the Spring Valley sources of supply and the much-needed extensions of the distributing plant, including all the work heretofore done by Mr. Hermann Schussler, who for many years received a salary of $25,000 per annum as Chief Engineer of the company, and is at the present time receiving $12,000 per annum from them as Consulting Engineer.

He must also take charge of the construction and completion of the Geary Street Railway and the contemplated extensions thereof. In addition, he will have charge of the completion of the sewer system, the Auxiliary High Pressure Water System for Fire Protection, the construction of the proposed tunnels, and all the ordinary work of the City Engineer. I venture to say that no corporation in the world, public or private, has a more extensive or varied program of immediate construction, involving the expenditure of a larger amount of money, than the City of San Francisco.

I deem this salary of $15,000 a year not exorbitant in view of the experience and prestige of Mr. O'Shaughnessy and of the magnitude and cost of the work to be done under his direction, in view also of the salaries usually paid to engineers of other enterprises.

I am confident he will be able, with many suggestions dictated by his experience, to save the City many times the amount of his salary.

A newspaper of the City, of September 1, 1912, states that soon after the appointment was made, the Mayor, who had called Mr. O'Shaughnessy to his office, said:

> Chief, you are in the saddle, you're it, you are in charge.
> Go to it, it's up to you, you must look on the City as your best girl and treat her well.
> Do what you think is best for her interests. Where reorganization is necessary, reorganize.
> We look to you with all confidence.

I expressed to the Mayor my strong objections to political interference by elected officials with the business end of engineering projects, and hence his comments. I got various letters from citizens, of which this is an excerpt:

> Dear Sir: This is what the people want. If you can do things (we don't care how), you are worth twice the price, but if you can't do things, you are dear at any price. We want things done. Good luck to you, don't mind red tape or a few dollars, but get things done.

The following article is from a sympathizing writer, Jack Lindsay, in a daily paper dated September 27, 1912:

BLUE PRINTS ARE FOR OFFICE FORCE
New City Engineer Man of Action
Theoretical Follows the Practical in City's
Many Important Engineering Problems.

The Mayor wears a self-satisfied smile these days when any mention is made of the office of the City Engineer. His trouble with that important bureau is at an end and if mention is

made that there is some engineering defect that needs attention, his answer is, "O'Shaughnessy has already taken the matter under consideration."

Judging from what has been done in the short time that the new City Engineer has been in charge, many intricate engineering problems which the City has in hand have been remedied. He has proven the confidence reposed in him by the Mayor and took hold of things personally and straightened out matters which tended to impede City progress and embarrass the administration.

He has not waited for the reports of his subordinates, sat in his office and studied blue prints and then compiled an elaborate and technical report without personal knowledge of the subject-matter. Nothing of the kind for this virile man. He investigates first personally; visits the spot where a correction is needed; makes a hasty, though no less accurate survey; arrives at his conclusions; tells what should be done and then gets his accurate measurements and the blue prints follow later; and the practical and theoretical are combined with good results.

He had not been in office a day before he was deep in the study of the Twin Peaks Tunnel project and there is going to be a straight-from-the-shoulder and a somewhat original report on this important matter in a short time. Condemnation suits had begun for the Glen Park reservoir site for a municipally owned water supply. O'Shaughnessy made a personal inspection before he was a week in office and in a day decided the exact amount of land which would be needed, and by his orders the excess was released from litigation immediately. There was no long preliminary announcement that he was going to Hetch Hetchy to study the City's proposed source of a water supply. The hustling engineer got up and went and spent ten days on foot and on horseback covering every foot of the ground and came back prepared to tell exactly what should be done, with a hundred or more arguments to support the City's contentions.

The Geary road engaged his attention at once and through his activity it will be placed in commission earlier than if some other man had been depended on to jog the contractors. He is still working on the Geary. For months little has been done about the extension to the ocean. There were excuses that legislation would be necessary to change street grades before the plans were made. O'Shaughnessy thinks different. Yesterday he took the Public Utilities Committee with him to the western end, showed where a street grade would have to be reduced several feet and the approximate cost thereof, and then in his blunt fashion told the committee to dig down and produce the cash to reimburse the property owners. This is probably what will be done without a long wait and references to committees and the passage of several ordinances. In the meantime the plans are complete and the City will soon be in a position to let the contract.

The Polk Street regrade has hung fire for months; O'Shaughnessy will soon have that straightened out.

There are many other matters; the San Bruno grade, the Ocean Shore, Butchertown sanitation, and other municipal problems which have been on the calendar for a long time.

Watch O'Shaughnessy wipe them off the slate.

For a short time in 1888, 24 years before, I worked as a transitman in the then City Engineer's office, and had a general knowledge of the routine work connected with City streets and land surveys. In those days very little authority for engineering was reposed in the City Surveyor. He had no responsibility for any structural features.

Under the new Charter framed by San Francisco under the auspices of Mayor Phelan in 1898, the general antique government of the City was reorganized, with a Board of Public Works of three commissioners appointed by the Mayor, at salaries of $4,000 each a year, assuming charge of all engineering work and vested with authority

in the selection of a City Engineer and City Architect. Under instructions from the Mayor, I was officially appointed by the Board of Public Works as City Engineer on the 1st of September, 1912, and all my reports to the Mayor and Board of Supervisors are made through the Board of Public Works. My predecessor, Mr. Manson, suffered from failing health. He had two technical assistants of high standing in his office, Mr. Loren E. Hunt, principal assistant engineer, and Mr. Thos. W. Ransom, consulting mechanical engineer.

An extensive system of sewer construction and a high pressure pipe system for fire fighting, costing over $5,000,000, had been under way for three years. My first activity in September was to spend two holidays with Mr. Loren E. Hunt, principal assistant engineer, going over the organization of the office and field forces, and making a survey of the different portions of work under construction. Mr. Hunt was a man of fine character and experience, having been previously engineer of tests at the State University at Berkeley, and many of the assistant engineers then employed on construction work were his former students. He died the first week of January, 1916. I found the spirit of the men in the office good, everybody trying to do the best they could for the City.

I canvassed with Mr. Hunt all the construction work under way, the percentage of each job completed, and the work that remained to be done, and I found his records in excellent condition.

Of the Auxiliary High Pressure Fire System there only remained two important units to complete, the construction of Station No. 2 at Fort Mason on North Beach, for pumping water into the system, and the design and construction of the Fire Alarm Station in Jefferson Park. There was also under construction the Geary Street Carbarn and the laying of tracks along Geary Street from Tenth Avenue to Market Street, and at the westerly end the job of grading and extending tracks from Geary Street and Thirty-third Avenue to Balboa Street and out to the ocean was not yet begun. The operation of the Geary Street Municipal Railway line along Tenth Avenue and Geary Street to Kearny Street commenced December 28, 1912. There were also under construction 43 steel cars for the Municipal Railway system by a San Francisco contractor who failed on the job. Plans were prepared and assessment levied for the construction of a tunnel in Stockton Street between Sutter and Sacramento Streets.

The first row I had, my first week in office, was over the plans and specifications for the Stockton Street Tunnel, which provided—on plans a year old—for a structure lined with concrete. The brick men and their agents, making war for their craft against concrete, said the work could not be done in concrete, there was no precedent for it, and nothing but brick would do for the lining. After giving those brick gentlemen an exhaustive hearing, I decided there was no merit in their contention and that the concrete lining would be just as effective, if not superior to a brick one. On April 11, 1913, a contract for this tunnel was awarded to Jacobson & Bade. They got the job finished before the 28th day of December, 1914, just before the Exposition opened and in

readiness for the construction and operation of an extension of the Stockton Street rail line along Columbus Avenue and Chestnut Street to the Exposition site.

Grave difficulties were encountered in the construction of this tunnel due to unstable ground conditions, as it had the widest span of any tunnel in the United States, being 50 feet in the clear inside the foundation walls. An additional 7 feet extra width had to be excavated on each side for the abutment walls, which made a severance of the formation 64 feet wide.

The character of the materials encountered was of a most composite nature, starting with good shale on both ends of the tunnel at Bush Street and at California Street, and running into very heavy schist near the center at Pine Street. The ground in front of the Metropolitan Life Insurance Company building sunk vertically over 2 feet, as it was a mass of very heavy clay, and the greatest care was exercised on the part of my engineer on this job, Mr. L. T. McAfee, and the contractor, Mr. Bade, to complete the tunnel without serious damage to adjacent property owners. By excavating the space for the two side walls first and pouring concrete in those sections of the tunnel lining, the central core of the tunnel was allowed to remain, the roof meanwhile being supported with heavy timbering and stulls or pipes filled with concrete projected from the core through the arch. The boarding house and hotel proprietors along both sides of the tunnel were constantly ringing on the phone and protesting against the explosion of blasts, giving us an unprecedented volume of kicks, which the hardened officeholder generally ignores. The assessment for the cost of this work was very nearly $700,000 and was apportioned to various property owners by a previous Board of Public Works, and much comment was aroused due to its inequitable distribution.

When the Twin Peaks Tunnel was started I resolved that we should avoid this conflict over cost and take charge of the assessment, with the accompanying burden of protests, and distribute it directly from the City Engineer's office, where men with skill and experience in this subject were trained. This plan was followed with relatively little kicking from over 30,000 property owners in a $4,500,000 project.

This consisted in building a tunnel 11,750 feet long from Eureka Valley at elevation 129 feet, climbing on a 3 per cent grade under Twin Peaks ridge to Laguna Honda Station at elevation 375 feet, and then descending southerly to the west portal at elevation 338 feet. The tunnel, 25 feet wide by 18 feet high, was designed for the use of a double track municipal street car railway, to bring rapid transit to 4281 acres of land beyond the peaks near the west portal. The route for this particular tunnel was initially planned by Mr. J. Rowland Bibbins, assistant engineer to Bion J. Arnold, well-known engineering expert of Chicago. He also contemplated extending the tunnel northeasterly from Eureka Valley down to Valencia and Market Streets, thereby adding about $3,000,000 to the cost. My previous experience 22 years before with assessment districts in San Francisco was educationally depressing, such as my previous work for taking Market Street over the top of Twin Peaks to the ocean and extending Potrero Avenue along the bay shore to the County Line, which was so illuminating and unfor-

tunate that I saw the utter impracticability of collecting one $7,000,000 assessment from the lot owners of San Francisco for this project, and I accordingly shortened the length of Mr. Arnold's tunnel about a mile to the route now operated and reduced the investment to about $4,000,000.

Four owners of large real estate tracts beyond the Twin Peaks hill took a very earnest part in aiding this project—they were A. S. Baldwin, Joseph Leonard and J. E. Greene, since deceased, and Duncan McDuffie, the planner of St. Francis Wood. A tunnel ordinance was especially drafted for the purpose of carrying through this work, and a special counselor, Theodore J. Savage, was retained by the interested property owners to assist the City officers in its legal consummation.

Surveys for the assessment district were made by Chas. H. Holcomb, an experienced Assistant City Civil Engineer. The total area included was 4981 acres, of which the westerly district comprised 4281 acres, and the easterly district, a narrow strip running down along Market Street on each side as far as Second Street, 701 acres.

The assessment rate varies from 3½ cents per square foot, in zones of estimated maximum betterment, to ⅛ of a cent minimum per square foot for those areas in the more remote regions.

It took a year and a half to get the plans ready and the assessment roll validated. The final contract for the tunnel structure amounted to $3,947,856.70. Work was commenced November 30, 1914, and was completed July 14, 1917, inside of three years, the schedule time, by R. C. Storrie & Co., the contractors, who were very high-grade construction men.

Opposition was offered to this tunnel from property owners who wanted the grade elevated at its southwest end so that it would reach the surface of the ground at Laguna Honda Station instead of being depressed 70 feet below the surface, and suits were instituted which were defended by the City and all opposition was finally killed.

Mr. McAfee, the same engineer who had charge of the Stockton Street tunnel, also conducted the construction of the Twin Peaks project, and made a fine construction record. After tunnel completion considerable protest was made against building the Municipal Railway by the construction of additional outer tracks down Market Street, opposition being propagated by the United Railroads, owning the central tracks. The company sought to restrain the construction of the outer tracks by injunction proceedings, and the whole matter was bitterly fought through the courts. This finally culminated in the sweeping decision of the Supreme Court of the United States on April 21, 1919, in favor of the City, when it was granted permission to operate cars on the outer tracks down Market Street. Dedicatory ceremonies on the completion of the tunnel were held on French natal day, July 14, 1917, and on February 3, 1918, the Twin Peaks Tunnel railway was operated down Market Street as far as Van Ness Avenue.

The completion of this tunnel has had a most wonderful effect in enhancing property values. Land in the first block near the southwest portal has risen in value from $20 a front foot in 1912 to $500 per foot in 1930, and the general level of all the

real estate west of Twin Peaks has improved from $10 a front foot up to $60 a front foot, in the region served by the tunnel. The earnings of the Municipal Railway have also advanced profoundly with the increased population in the district, the receipts from the "K", "L", and "M" lines having increased from $250,886.90 for the year 1919 to $691,024.65 in 1928.

All kinds of false predictions were made as to the influence of four tracks on Market Street, which the practical operation of the line proved to be absolutely untrue. The business of the Emporium, the largest store, increased from $10,126,042 in 1918 to $20,686,630 in 1928, or practically double. Hale Brothers retail dry goods store has increased its business four times since the four tracks were operated. So that fabricated propaganda put forth by antagonists of the City's policy that four tracks would injure the business interests of Market Street had no foundation.

CHAPTER II

Hetch Hetchy

ON THE same Saturday afternoon that I was appointed City Engineer, August 31, 1912, the Mayor told me I should call on Mr. John R. Freeman at the St. Francis Hotel and discuss with him the coming brief to be presented in Washington in November on the application of San Francisco for rights in Hetch Hetchy. I had previously been familiar with the water project only from newspaper discussions, which were quite active for practically a score of years before my advent on the scene.

The first map on record on the Hetch Hetchy Project was by J. P. Dart, engineer, Sonora, who made a plan of the canal from the mountains to San Francisco, for the Tuolumne and San Francisco Water Company in May, 1882.

The next important work was by a countryman of mine, John Henry Quinton, Civil Engineer of Los Angeles, California, who in an original report for the United States Geological Survey in the year 1891 made the first recommendation as to the use of the Hetch Hetchy Reservoir for a source of supply, adverting on its great purity, freedom from contamination, and appropriateness as a source for San Francisco. Through the initiative of Carl E. Grunsky, former City Engineer, Mayor James D. Phelan made water filings on July 29, 1901, for reservoir and rights of way within the Yosemite National Park upon what are known as the Lake Eleanor and Hetch Hetchy reservoir sites. This application was denied by the Secretary of the Interior in December, 1903. The City's policy for acquiring those sites was definitely abandoned by the corrupt administration of Mayor Schmitz in 1906, and it was not until April 22, 1908, that my predecessor, Mr. Marsden Manson, resurrected it by filing duplicates of the original Phelan maps of the two reservoir sites with James Garfield, Secretary of the Interior. This gentleman on May 11, 1908, granted the City what is known as the Garfield Permit, which granted the City primary rights in Lake Eleanor and secondary rights in Hetch Hetchy, and which was accepted by the Board of Supervisors under Mayor Edward R. Taylor, on June 4, 1908.

On the strength of this permit and estimates of cost by Mr. Manson, the City, on January 14, 1910, voted $45,000,000 of 4½ per cent bonds to carry through this project.

Mr. Garfield was succeeded as Secretary by Honorable R. A. Ballinger of Seattle, who on February 25, 1910, in view of reports made to him as to the adequacy of Lake Eleanor, required the City and County of San Francisco "to show cause why the Hetch Hetchy Valley and reservoir should not be eliminated from such a permit."

A Board of United States Army Engineers, comprising Colonels Biddle, Cosby, and Taylor, was appointed to make a disinterested survey of the problem. This action compelled the City to employ John R. Freeman, Civil Engineer of Providence, Rhode Island, as Chief Consulting Engineer, with several other engineers, to present its case

in a proper manner before the Department of the Interior and prepare facts for the Army Engineers, so their good opinion would be fair to San Francisco.

Mr. Walter L. Fisher of Chicago succeeded Mr. Ballinger as Secretary of the Interior and he was the gentleman who presided at the hearings in Washington in 1912. Mr. Freeman was an engineer of great versatility and broad experience, having been consulting engineer for the City of Boston and for the City of New York on its Ashokan water supply. I called on him at the St. Francis Hotel on that Saturday afternoon and had a very pleasant interview of a couple of hours, in which many features of his activities for the past year in connection with Hetch Hetchy were discussed. Assistant City Attorney John F. English, a subordinate to Percy V. Long, City Attorney, also called at the same time and we discussed legal features of the project.

The City then had only three men employed permanently on Hetch Hetchy, principally engaged in measuring water. They were E. J. Koppitz, hydrographer, Chas. E. Hill, both of whom resided in a cabin in Hetch Hetchy Valley, and O. J. Todd at Lake Eleanor.

I discussed engineering and physical features with Mr. Freeman, who gave me his impressions of the character of the men employed by the City to help me on in undertaking my work.

On Saturday, September 14, 1912, I left San Francisco at 9 a. m. to visit Hetch Hetchy, and arrived, via Oakdale, at Chinese, on the Sierra Railway, at 4:10 p. m., where I took a 2-horse stage over the old wagon road to Groveland. Took supper at Jacksonville and arrived at Groveland at 9 p. m., and stayed at Baird's Hotel. On Sunday, September 15th, left Groveland on a buckboard at 9 a. m., calling on Mr. Wiley, agent of the Yosemite Power Company, 3 miles east, who represented this corporation in which John Hays Hammond had interests. This call was made at the request of John Coffey Hayes, who was Mr. Hammond's San Francisco agent, and his nephew, and who also was interested in the Yosemite Power Company's project.

The Forest Service, at the request of Mr. Manson, had declined to grant the Yosemite Power Company any approval of rights which might conflict with the plans of the City and I confirmed this attitude by telling Mr. Wiley I would not consent to interference of any outside corporations with the City's water business.

Arrived at Hamilton's at 12 noon, left on a buckboard at 1:30 p. m., climbed the ridge past South Fork and reached the City's log cabin at Hog Ranch, the end of the road, at 6:10 p. m. An attempt was made by the most fastidious of our officials to change the name of this place to Portulaca, but the old name still trailed on. The only building in this region owned by the City was this old log cabin, which needed underpinning. The foundation was rotted and the floor was loose and sagging. There was an abundance of cedar logs in the vicinity for this work.

A soldiers' camp existed about 200 yards north of the cabin, in which three or four soldiers were stationed in a tent. The whole of the Yosemite National Park was patrolled by a company of soldiers at this time.

Monday, September 16th, left Hog Ranch on horseback by trail, with Hank Williams, pioneer of the mountains, with two horses and one pack mule, and arrived at Hetch Hetchy cabin at the bottom of the valley at 2:10 p. m. Half-way down the trail I met Secretary of War Stimson, afterwards Governor of the Philippines, escorted by a troop of soldiers, making a horseback pilgrimage through the Park, shook hands with him, and wished him Godspeed on his journey.

At Hetch Hetchy cabin I met Mr. Koppitz and Mr. Hill, the two City employees, and explored the valley on foot up to the Little Hetch Hetchy Valley, sizing up the bluffs and vertical walls of granite which lined the valley rigidly on each side. Those two men were engaged in daily measurements of the water by means of current meters and depth gauges. Only 150 people had visited the valley during the past year, of whom two were from New York.

The mosquitoes were then an aggressive pest, propagating in the swampy vegetation on the floor of the valley, which was submerged each spring by floods. It was my firm impression that the presence of a lake with a depth of water to exterminate the mosquito pests would be a blessing and a comfort to the neighborhood and to all visitors.

I explored bedrock on the bluffs at the Hetch Hetchy damsite and noticed that the stream was about 100 feet in width, with good granite rock on both sides, from which a loose rock talus had fallen down and filled the gorge at the bed of the stream with debris, so as to make it a natural dam, which served occasionally in flood periods to drown the valley with water.

At 8 a. m. Tuesday morning, September 17th, left Hetch Hetchy cabin, 3500 feet elevation, forded the river, and rode with our packs up the trail to the Eleanor ridge, which was about 5500 feet above the sea level. At 11:30 reached Lake Eleanor, elevation 4600. Lake Eleanor was excavated by tremendous glacial action in ages long gone by, when the natural granite rock was ground out by pressure from the massive mountains of ice, and the resulting debris from the melting glaciers was deposited in the shape of a gravel mass immediately below the lake, where for a width of a quarter of a mile is a natural deposit of sand and gravel, making excellent material for concrete.

I examined the possibility of making a low dam at Lake Eleanor to raise the level of the water 30 or 40 feet and tentatively decided on a suitable location where pits could be sunk to determine the depth of the gravel. I also explored the riverbed a mile below the lake, where good granite bedrock was exposed in the streambed, which presented favorable characteristics for the assured construction of a masonry dam. No soundings had yet been made of the depth of water in Lake Eleanor and I gave instructions to Mr. Todd to have a set of soundings made, clear across the bottom of the lake, as one of Mr. Freeman's projected plans contemplated driving a tunnel from Cherry, under the lake bed, across to Hetch Hetchy. I also gave instructions to Mr. Todd about making preliminary reconnaissances for road surveys both at Eleanor and Hetch Hetchy.

On Wednesday, September 18th, 7:30 a. m., left Eleanor with George Bartlett as guide. Went down past the damsite to William Hammond Hall's camp on Cherry

River, recently purchased by the City, about three miles distant. A lot of shacks were erected around here in a pretty wooded meadow in connection with a temporary sawmill. No good bedrock seemed to exist in Cherry River and the thought was at once advanced that instead of building a dam at Cherry, a better plan was to build a high level canal of large capacity, 3 or 4 miles long, across a sag in the hills to bypass the floods from Cherry over the higher slopes to the desirable Eleanor damsite. Thence proceeded by trail down the Cherry River watershed to Cherry mouth, the junction of Cherry River with the main Tuolumne. Had a glance up the riverbed towards Early Intake, above which I discovered that Mr. Hammond had us blanketed with an 80-acre purchase of a piece of land, some six miles above, at Poopenaut Valley, from which he contemplated leading a conduit down the south side of the Tuolumne to a future power station, which would embarrass our water rights and be in serious conflict with the City's plans. It was only lately I discovered that those gentlemen were supposed to have purchased this land in Poopenaut Valley from the late Senator Curtin.

At 4:15 p. m. crossed Lumsden's bridge and at 4:30 p. m. arrived at the Agricultural Permit land location of the City, on which the City had a filing under Forest Service rules, and cut two or three tons of hay each year.

At 4:45 p. m. crossed the South Fork of the Tuolumne, where there was a partially built bridge, and a camp composed of three tents, used in road construction to this point. This camp contained tools, implements, and cooking apparatus, the property of the City, stores for construction purposes, in conjunction with the road which Hamm Hall was building from the high ridge down to the South Fork of the Tuolumne River Valley under an arrangement with the City.

I discussed questions of immediate needs with Mr. Bartlett and one of the first was the construction of a No. 9 telephone wire from Hog Ranch across Hetch Hetchy to Lake Eleanor. The existing No. 14 wire of the Yosemite Park authorities, while serviceable in summer, was entirely too light for winter use, and got broken after every slight snowstorm.

After supper at Hamilton's, drove to Groveland and had conference with Mr. Cassaretto, storekeeper, in which he pressed for a subscription from the City towards the new wagon road which would cut out the steep grade at Priest Hill down to Moccasin Creek.

Thursday, September 19th, left Groveland at 4 a. m., reached Chinese at 8 a. m. and caught the Southern Pacific train for San Francisco, arriving at 3 p. m., with six samples of rock from Hetch Hetchy and Eleanor damsite and about 30 photographs which I snapped with my camera.

September 20th, next day, I gave a press interview to the San Francisco newspapers in which I stated, "the country, while rough, was not as forbidding as portions of the Hawaiian Islands where I completed 32 miles of tunnels in about 4 years, but I was much impressed with the great valley of the Hetch Hetchy damsite from a structural point of view, as it was very narrow, possessing excellent bedrock, furnishing every

encouragement to rapid and successful dam construction, and that its possession and use was indispensable to the interests of the present half million and the future 4 million residents of San Francisco." I stated that the construction of a dam would add to the scenic features of the country, that all objections of alleged nature lovers should be overruled, and the necessary permits should be issued by the Department of the Interior, with instructions to proceed. The City Engineer could not conceive why the City of San Francisco, with all its tribulations, should be subjected to the antagonism of the Washington departments in endeavoring to acquire a watershed. The only exception was the Forest Service, which thus far has been fair and friendly.

This forms quite a contrast to the attitude of the United States Geological Survey in the Los Angeles-Owens River matter, when they turned over all their survey data which they had developed for years for the farming communities to the City of Los Angeles, and cooperated in every way with the officials of that city to accomplish the project.

I regarded Lake Eleanor and Cherry Creek of great future value as water sources by extensive dam construction and unhesitatingly declared that where the City is going to spend over 40 millions in mountain development of water supplies it should build the dam at the best site first, and hoped the Board of Army Engineers would approve of Hetch Hetchy for that purpose. I regarded the watershed as ideal for domestic use, being entirely free from any contamination and fed for eight months of the year from melting mountain snows off granite ledges, giving water of the softest quality, free from mineral ingredients or animal contamination of any kind.

After my visit to Hetch Hetchy I addressed the following letter to Major W. W. Forsyth:

September 27, 1912.

Major W. W. Forsyth,
Major, Sixth Cavalry, U. S. A.,
Yosemite, California.

Dear Sir: In connection with the water development of the City of San Francisco on Cherry Creek, Eleanor and Hetch Hetchy, the location of a desirable trail which might in future be converted into a wagon road is a matter of much importance. I understand from Mr. Todd, one of our engineers on the ground, that you have said it is necessary for the City of San Francisco to apply to the Secretary of the Interior for permission to do this work inside the Yosemite National Park. Of course it would first be necessary to get an accurate survey of the route and then apply for permission on behalf of the City of San Francisco to do the construction work, as per the accompanying map on which I have tentatively outlined the possible location.

After the trail or route is definitely located and approved by the engineering department, then it would be in order to do preliminary grading or have the trail niched out so as to find it on the ground before a permanent location would be decided. Subsequently, after meeting your approval, it would be in order to make a wagon road along this location.

TELEPHONE LINES. The City is contemplating building a heavy No. 9 wire line between Hamilton's and Portulaca (Hog Ranch), which is entirely outside of the Yosemite National Park.

I suppose you are aware of the fact that the No. 14 wire on the telephone line between Portu-

laca and Hetch Hetchy Valley and Eleanor is now out of repair a good part of the time because the wire is so very small in diameter and is easily broken by wind or falling tree limbs. This causes interruption of the service which must be very inconvenient to your Department. I would like to know whether you would consider the proposition of co-operating with the City in laying heavy wire, No. 9 wire, between Portulaca (Hog Ranch), Hetch Hetchy and Eleanor.

Regretting that I did not have the pleasure of seeing you while visiting the Valley, I beg to remain

Most respectfully yours,

(Signed) M. M. O'SHAUGHNESSY,
City Engineer.

MMO'S/AMO

Reply by Major W. W. Forsyth to foregoing letter:

DEPARTMENT OF THE INTERIOR
YOSEMITE NATIONAL PARK
Office of the Superintendent

Yosemite, Cal., October 17, 1912.

Mr. M. M. O'Shaughnessy, City Engineer,
Board of Public Works, Bureau of Engineering,
San Francisco, California.

Sir: Referring to your letter of September 27, 1912, making application to build a trail from Cherry Creek to Lake Eleanor, and from Lake Eleanor to the Hetch Hetchy and on to the Hog Ranch, to be used in connection with the water development of the City of San Francisco, the application in question was duly forwarded to the Secretary of the Interior, and a reply under date of October 11, 1912, has been received, as follows:

"In response I have to state that the Department has no objection to the City of San Francisco making survey of the trail in question across the park lands from Cherry Creek to Lake Eleanor, and constructing a trail along such line, the work to be done under your supervision and to your satisfaction.

"No action, however, can be taken at this time upon the request for permission to make survey from Lake Eleanor to Hetch Hetchy and from the point beyond Hog Ranch to Hetch Hetchy, in view of the fact that the question as to whether the permit authorizing the City of San Francisco under certain circumstances to occupy and use for municipal power purposes lands in Hetch Hetchy Valley shall be revoked has not yet been determined. The date now fixed for oral arguments on the subject is November 27, 1912."

Very respectfully,

(Signed) WM. W. FORSYTH,
Lieut.-Colonel, First Cavalry,
Acting Superintendent.

EPL—L

Mr. Freeman had a tremendous engineering organization to aid him in the presentation of his data. Mr. Manson having become sick, Mr. C. E. Grunsky was drafted temporarily before my advent as City Engineer to supply his place, and to help Mr. Freeman in the presentation of his case.

Mr. Drenzy Jones, Surveyor from Tuolumne County (since deceased), and Mr. Max J. Bartell, an assistant City Engineer, were the principal aids in the City office to the work of Mr. Freeman.

A more careful perusal of the subject and recommendations contained in Mr. Freeman's report induced me to modify his road program considerably. He recommended an absolutely uniform road grade line descending on 3 per cent grade down the south bank of the Hetch Hetchy Canyon to the confluence of the South Fork, via the Early Intake, *rigorously adhering to straight grades regardless of occasional ledges and cliffs.* On my reconnaissance I found this road would be impracticable, undesirable, and extremely costly, and instead adopted a route that rose a vertical height of 1200 feet from the dam-site on a 4 per cent grade to Poopenaut summit 5070 feet above the sea, and then stayed along the ridge clean down to Groveland, eventually meeting the main line railway at Hetch Hetchy Junction, straddling our aqueduct line and power location along the route.

Mr. Freeman is entitled to much credit for originating the brilliant conception of raising the project from a miserable 60-million-gallon daily application to one of 400 million gallons daily, having in mind the thought of the future expansion of San Francisco with the commerce of the Panama Canal and the other stimulating commercial features of the future. For this one idea alone his services were very well worth double all that he received in the way of compensation, and any changes I have recommended in the modification of his plans were due to a more intimate study of the detailed technique of the ground after thorough examination, and were not intended to be critical of the plan prepared by Mr. Freeman.

The Spring Valley Water Company up to this time was extremely active in fighting the City's application for Hetch Hetchy by stimulating the farmers of Turlock and Modesto to oppose our grant and in the way of advancing claims to the tremendous volume of water in their terrain, and on November 2, 1912, filed a 506-page voluminous report by Engineers Schussler, Fred. Herrman, George D. Anderson, Mulholland, Lippincott, LeConte, C. H. Lee, and other engineers of the company, and by Geological Professors Branner of Stanford and A. C. Lawson of Berkeley.

CHAPTER III

Scenic Lovers' Protests on Hetch Hetchy

AMONG the objectors to San Francisco's application were the Sierra Club, Society for the Preservation of National Parks, American Civic Organization, American Scenic and Historic Preservation Society, John Muir, William F. Bade, E. T. Parsons, William E. Colby, and other objectors to Hetch Hetchy. After the printing of Mr. John R. Freeman's brief submitting report to the Army Board September 1, 1912, all the eastern sections of the United States were aroused by the activities of the above-named organizations in opposing the grant of Hetch Hetchy.

The American Civic Organization on October 17, 1912, addressed Walter L. Fisher, Secretary of the Interior, as follows:

AMERICAN CIVIC ORGANIZATION

Hon. Walter L. Fisher,
Secretary of the Interior,
Washington, D. C.

October 17, 1912.

Dear Sir:

. . . . . .

1. The question in discussion before you is consequent upon a letter, addressed on February 25, 1910, by your immediate predecessor to the Mayor and Supervisors of the City and County of San Francisco, notifying those officials "to show why the Hetch Hetchy Valley and reservoir site should not be eliminated from the permit granted by Hon. James R. Garfield as Secretary of the Interior, on May 11, 1908."

Hearings were had on May 25, 1910, and at other dates, in pursuance of this order, and it appearing that the City of San Francisco was utterly unable, from any information it possessed or had acquired since the beginning of the Hetch Hetchy effort, October 15, 1901, to make answer, an extension was granted by your predecessor to June 1, 1911.

Various other extensions have since been granted at the request of the City of San Francisco, so that the hearing now set for November 29, 1912, is presumably the first complete answer to be offered by the City and County of San Francisco to the order of your predecessor, issued February 25, 1910.

. . . . . .

Nor do I here discuss in any detail the voluminous report made to the Mayor and City Attorney of San Francisco by John R. Freeman, a noted and able civil engineer of Providence, Rhode Island, entitled "On the Proposed Use of a Portion of the Hetch Hetchy, Eleanor and Cherry Creek Valleys . . . for the Water Supply of San Francisco, California, and neighboring cities."

It is desired only to present to your attention the fact that Mr. Freeman's opinion in this case is worth exactly and only that of any attorney who might be presenting before a court of adjudication any claim which he was paid to favor. It has at no time been suggested that Mr.

Freeman has been retained by the City of San Francisco for any other purpose than to justify it in its claim as to the necessity for the further extension of the so-called Garfield permit. It is also in point to call attention to the fact that Mr. Freeman's report differs radically from the previous propositions of the City of San Francisco, and essentially discredits the offers and findings of the engineers previously employed by the City for the same purpose.

2. The matter under discussion rests absolutely on the third proviso in the permit given to the City of San Francisco under date of May 11, 1908, by your predecessor, Hon. James R. Garfield, which is as follows:

"The City and County of San Francisco will develop the Lake Eleanor site to its full capacity before beginning the development of the Hetch Hetchy site, and the development of the latter will be begun only when the needs of the City and County of San Francisco and adjacent cities which may join with it in obtaining a common water supply may require such further development."

It is in point here to call attention to the fact that pursuant to an application first made by James D. Phelan, on behalf of the City of San Francisco, October 15, 1901, Hon. E. A. Hitchcock, then Secretary of the Interior, after many hearings and full consideration, denied the City's application in these words:

"Having in view the ends for which the Yosemite Park was established and the law which clearly defines my duties in the premises, I am constrained to deny the application."

Mr. Hitchcock here refers to the act of Congress of October 1, 1890 (26 Stat. 651), which, among other stated purposes, included

"the preservation from injury of all . . . natural curiosities and wonders within said reservation (the Yosemite National Park) and their retention in their natural condition."

This act followed an agitation carried on by public-spirited persons from all over the United States for the preservation of the then threatened wonders of the Yosemite National Park. No such agitation and no publicity was attached to the passage of the act of February 15, 1901, under which

"The Secretary of the Interior . . . is authorized . . . to permit the use of rights of way through . . . the Yosemite, Sequoia, and General Grant national parks, California, for . . . water conduits and for water plants, dams, and reservoirs used to promote . . . the supply of water for domestic, public, or other beneficial uses."

(See Exhibit "X", page 31.)

I respectfully urge you that this act of February 15, 1901, was the sort of legislation all too frequently enacted, without due thought in the premises, and which an officer charged with high duties might well construe essentially in the public interest. This act did include a provision, to which I now direct your attention, for it provided that the permit above referred to for destroying the original purpose, well stated, of the act of October 1, 1890, was to be accomplished

"only upon the approval of the chief officer of the Department . . . and upon a finding by him that the same IS NOT INCOMPATIBLE WITH THE PUBLIC INTEREST."

The permit granted by the Hon. James R. Garfield under date of May 11, 1908, specifically disclaimed any discussion that the Hetch Hetchy Valley was "the only practicable and reasonable source of water supply" for San Francisco. To many who talked with him and to many who wrote to him Mr. Garfield expressed himself as relying on the provisos of the permit as protecting the public in the enjoyment of the Hetch Hetchy Valley for many years, if not forever, because he

had specifically provided that the City should "develop the Lake Eleanor site to its full capacity before beginning the development of the Hetch Hetchy site."

3. The City of San Francisco, acting upon this permit, has, according to a statement made before the Advisory Board of Army Engineers at the hearing of May 25, 1910, as reported on page 62 of the printed report of that hearing, in the words of its City Attorney, Percy V. Long, "authorized a bond issue of $45,000,000 for the development of the Lake Eleanor system."

4. Although technically the discussion now before you is upon the order to show cause issued February 25, 1910, by your predecessor, obviously San Francisco is not at all making an answer upon that order alone. On page 150 of the heretofore cited Freeman report a statement is made "that the Garfield Permit has become practically worthless," and this statement is elsewhere constantly reiterated in Mr. Freeman's report, to which at the hearing to be held in November I shall hope to refer in respect to its lamentable insinuations, unfairness, and reiterated misstatements.

5. In view, therefore, of the fact that the City of San Francisco has abandoned any pretense of adherence to the details of the Garfield Permit and that its engineer-attorney specifically says that permit "has become practically worthless," I now respectfully suggest that the permit be at once and in whole revoked and that San Francisco be requested to make a new application for exactly what she wants, to which due attention can be given in the public interest and under your wise consideration.

I make this suggestion as in the nature of what before a court would be a motion for a non-suit, inasmuch as the defendant is not pleading to the issue that has been joined.

Should, however, this hearing be continued in its present form, I desire to submit as one of the many reasons for declining to continue the Garfield Permit and to extend its breadth and terms, that the Freeman report and the contentions of the City of San Francisco are not sincere, fair, or truthful, evidence of which I shall hope to present at the hearing of November 29, in extended form.

For this present statement I wish to refer you only to, first, the many places in the Freeman report in which insinuation is made as to the good faith of those who are interested in preserving the scenic wonders of the United States, and to the frank disagreement of engineers in respect to the use of the Hetch Hetchy site as an available source of water supply for the City of San Francisco. Indeed, the officials of that City have not by any means been always in favor of using the Hetch Hetchy, and it is no disrespect to a great community to say that the political conditions which have been for many years notoriously prevalent in San Francisco do not lead to a feeling of agreement either as to the ability, public spirit or wisdom of the officers of the City charged with obtaining proper facilities for its great population. On October 8, 1906, the (Eugene Schmitz) Board of Supervisors of the City and County of San Francisco specifically adopted the report of the "Special Committee on Water Supply", in which the statement is made that

"The Hetch Hetchy system was not originated to get a water supply for San Francisco. It was originated to prevent San Francisco from getting a water supply."

In this same official document, fourteen other sources of water supply are suggested.

6. The claim has constantly been made that there is nothing especially remarkable about the Hetch Hetchy Valley; that it is a mosquito-ridden valley, visited by few persons, inaccessible, and without facilities for camping, and that there are hundreds of other places in the Yosemite National Park better adapted to the uses of tourists.

The completest answer to these reiterated statements is found in a document published by the

Department of the Interior entitled, "Sketch of Yosemite National Park . . . and an Account of the Origin of the Yosemite and Hetch Hetchy Valleys," by F. E. Matthes, of the United States Geological Survey, which in scientific phraseology discusses without heat or prejudice the whole situation, not in respect to water supply potentialities, but in respect to the character of the scenery which it was the undoubted intent of the act of October 1, 1890, to preserve "in their natural condition." All through this admirable document the exact parallelism between the Yosemite Valley and the Hetch Hetchy Valley is constantly stated. I bring to your attention but one phrase from this document, which in its introduction says:

"Within this area lie scores of lofty peaks and noble mountains, as well as many beautiful valleys and profound canyons; among others, the Hetch Hetchy Valley and the Tuolumne Canyon, each scarcely less wonderful than the Yosemite Valley itself."

It is this extraordinary region, the geological features of which are shown to be marvelous, that is the subject of the assault of the City and County of San Francisco.

I can properly recall your attention to that of which I know your own eyes have already convinced you, as incident to the visit you made to the Yosemite National Park in September, 1911, that the Hetch Hetchy Valley is grandly beautiful, that there are numerous and beautiful camping sites and great and splendid trees in its floor, that there are no camping places accessible along its approach, and that it is similar to and as remarkable as the main Yosemite Valley itself.

7. I wish to point out but one other inconsistency in the Freeman report, as referring to the Hetch Hetchy Valley as a pleasure resort. In paragraph 180 Mr. Freeman says:

"Notwithstanding the Hetch Hetchy Valley has for some years past been one of the best advertised pleasure spots in the United States . . . very few campers go there for pleasure and the number from outside the State of California is particularly small."

. . . . . .

8. In the extended statement which it is hoped to present later, I shall advert to the wrong of taking one square inch of available area from our all too scanty provision of national parks; to the specious statements of Mr. Freeman in what he says concerning the protection of the watershed involved; to the radical differences between his statements and those upon which alone Secretary Garfield granted the permit now under discussion; and to the extraordinary situation under which the City of San Francisco induced its people to vote $45,000,000 for the development of a water project the adequacy of which it now denies, while probably spending some of the bond issue thus authorized in exploiting the claims of an extended source restricted from it by the terms of the Garfield Permit. I shall ask to have considered the views of those who have to do with the welfare and efficiency of the American public as related to recreation. I shall want to bring to your attention the action of other nations in preserving for all time great natural wonders. I shall desire to point out the fallacy of the propositions to build a road not connecting at all with the existing road system of the Yosemite and to erect a lake to which access could scarcely be had and bordering upon which sites for the accommodation of the sightseers are practically non-existent.

Confidently relying upon your public spirit in construing this matter for the good of all the people, I ask you, first, to at once revoke the Garfield Permit as not being acted upon in sincerity, and, second, if this be not deemed wise in your view, to refuse to San Francisco any further extension of that permit unless the Board of Army Engineers shall show that there is no other available and practicable source of water supply at the command of the City of San Francisco. In this latter event I urge that expense to the City of San Francisco be not given too great weight. It is not a reason for taking half the area of the Yosemite National Park from the public use

eventually that the City of San Francisco would need to pay money for what she has here the desire to pay nothing.

Respectfully submitted,

J. HORACE MCFARLAND,
President.

M/G

Mr. McFarland was a little unfortunate in referring to the action of the notoriously crooked Schmitz Board, which, on October 18, 1906, sought to abandon Hetch Hetchy, no doubt for the promotion price to be paid by a rival scheme fathered by Mr. Tevis.

EXHIBIT "X"

In connection with the able report of the Yosemite Park Commission, comprising H. M. Chittenden, Major of Engineers, U. S. A.; R. B. Marshall, Topographer, U. S. G. S., and Frank Bond, Chief of the Drafting Division, U. S. G. S., prepared August 31, 1904, with recommendations to the Secretary of the Interior, the following allusion is made to San Francisco's watershed:

Moreover, this watershed is particularly prized by the people of California for the use it will yet be to the State, and already a large portion of its water is appropriated and the time may soon come when municipal needs will further draw upon them. There is overwhelming sentiment in favor of its thorough protection from denudation or contamination by grazing. Well-chosen reservoir sites in the upper valleys of these streams, if judiciously utilized under government supervision, would add beautiful lakes and landscapes, maintain the cataracts throughout the season, at the same time conserve water for the people below. This possibility is suggested merely to show that the Park boundaries as proposed by the Commission have nothing within them that should jeopardize the integrity or mar the natural beauty of the reservation in the future.

ROADS: These roads, not of very great extent, would be the main part of the system. Radiating from them there should be a few side roads leading to some of the principal attractions outside the valley and for use by the troops and scouts in patrolling the Park. There should be a road to and through the proposed reserved tract around the Merced and Tuolumne groves of big trees. This would be an important side drive. The present Wawona road gives access to the Mariposa Grove of big trees outside the Park, or possibly a better route may be found by way of the Bridal Veil Meadows and Chilnulna Falls. There should be a road to the Hetch Hetchy Valley, another to the Soda Springs, another practicable and at reasonable cost up the Little Yosemite Canyon as far as Merced Lake. None of these roads would be of great length.

Memorandum by the Commission:

Section 1. Macadamized Road. We will consider the low line next the river by far the more desirable, adding to the foregoing estimate 10 per cent to cover contingencies given.

For Section 1 from the proposed west boundary of the National Park to the west boundary of the Valley grant	$138,000
For Section 2 from the proposed west boundary of the National Park to the present west boundary	43,000
Total	$181,000
For placing the Tioga road in a state of thorough repair	$ 30,000

RESOLUTION 6949

Whereas, The inadequacy of the water system of the City, the ever-increasing demand for water, the constantly augmenting price of available water sources, and the constantly diminished possibility of securing such supplies, due to other uses and appropriations, make it absolutely imperative that a municipal water supply be at once acquired; and

Whereas, the City has expended thousands upon thousands of dollars in tentative efforts to secure the Tuolumne or Hetch Hetchy system, but from the history of the proceedings already taken, as well as from a letter just received by the City Engineer from Congressman J. C. Needham, it is apparent that said Tuolumne supply cannot be acquired for years to come, if at all, and probably not at all; and

Whereas, To continue vainly in this direction will only aid the Spring Valley Water Company to prolong its grasp on the people of San Francisco and will in the end cost the City millions of dollars in increased cost of the municipal water supply which must eventually be acquired, as well as in continued payments of exaggerated water rates to the present supply company; and

Whereas, No greater advantage can accrue to the City than the immediate acquisition of a sufficient supply of pure fresh water, all of which facts have been forcefully and succinctly presented to this Board in the third inaugural address of his Honor Mayor Eugene E. Schmitz, whose statements and declarations in said address on this subject this Board hereby unqualifiedly endorses and hereby expressly adopts; therefore, be it

Resolved, That the City refrain from expending further money, energy or time in the futile attempt to acquire the so-called Tuolumne system; that the Committee on Water and Water Rates of this Board, in conjunction with the Chairman of the Finance Committee and the Chairman of the Committee on Public Utilities, be and they are hereby appointed a special Committee with directions and instructions to proceed at once to investigate other available and adequate sources of supply of pure water from the Sierra Nevada Mountains and to report upon the same to this Board at the earliest possible time in order that steps may be taken tending toward their immediate acquisition if they be found accessible, sufficient and available. And the City Engineer is hereby directed to place at the disposal of said Committee all data and information in his possession relative to such or any sources of proposed supply.

And the Clerk is hereby directed to advertise this resolution in the Evening Post newspaper.

In Board of Supervisors, San Francisco, January 29, 1906.

Adopted by the following vote:

Ayes: Supervisors Boxton, Coffey, Coleman, Davis, Duffey, Furey, Gallagher, Harrigan, Kelly, Lonergan, Mamlock, McGushin, Nicholas, Phillips, Rea, Sanderson, Walsh, Wilson.

GEO. B. KEANE, *Clerk.*

Approved, San Francisco, February 3, 1906.

E. E. SCHMITZ,
Mayor and Ex-Officio President of the Board of Supervisors.

From the

BRIEF OF SIERRA CLUB IN OPPOSITION TO GRANT OF HETCH HETCHY VALLEY TO SAN FRANCISCO FOR A WATER SUPPLY

[After citing the opinions of various lovers of nature and scenic beauty, the protestants launched into a discussion of the sanitary features as follows:]

PROBLEMS OF SANITATION

That part of the report which relates to sanitation contains such astoundingly erroneous statements that one is fairly startled. The name of the distinguished engineer appended to them only adds to one's surprise.

1. The discussion of the sanitary rules needed to render the water supply hygienically safe proceeds upon an entirely mistaken assumption regarding the kind of use to which campers and tourists are now putting the park. This is shown, for instance, by the contradictory statements on pages 55 and 34, where in one case bathing is to be prohibited, and in the other it is stated that "no limit which does not now exist need be placed on the use of the park for camping purposes".

It is assumed that the use of Yosemite National Park is analogous to that of some city park where people view the scenery from the roadway and live at hotels or fixed camps. This is clearly impossible where people must and do move their own camping outfits over an area comprising many hundreds of square miles. Fixed camps are susceptible of sanitary supervision. But hundreds of people moving independently from point to point, carrying their own outfits and camping at a new site every night, are not susceptible of sanitary supervision. Yet, to put a check upon them is to deprive them of the best recreational use to which the Park is now being put. Steep slopes, impervious soils, and frozen ground greatly increase the danger of pollution that arises from such promiscuous camping. To such conditions the arguments presented by picture and paragraph in the City's report has no application, because in the examples cited people either do not live and camp on the area, or else live at certain fixed places where extraordinary measures have been taken to guard against pollution, and where the public is under strict police supervision.

As will be clearly shown farther on, the sanitary rules of all the protected watersheds cited as analogous cases by Mr. Freeman prohibit camping on the edge of streams and reservoirs, and bathing or washing in the same. But as anyone knows who has camped at all in the Sierra Nevada, proximity of a camp to flowing water is so necessary for the comfort both of man and of beast that an outing in the park would lose all its charms without it. For example, of the two hundred and more persons who annually visit the park regions as part of the Sierra Club outing alone, few miss the luxury of a regular daily bath in the waters which Mr. Freeman gratuitously assumed would have no attraction by reason of their coldness, but in which bathing will have to be forbidden. Does anyone suppose that the many hundreds of people who go camping for four weeks at a time in the Tuolumne Canyon and upper watershed carry along tubs, or postpone their baths for that period? The forbidding of bathing in the Tuolumne and its tributaries means practically no bathing within an area of about 450 square miles containing most of the finest scenery in the park. This alone is a serious impairment of the use of that area as a recreation ground.

2. It seems incredible that an engineer should minimize the need of sanitary safeguards to the extent to which it is done in this report. On pages 32-52 an appeal is made to all the laxities of sanitary control which could be used to "prove the utter absurdity of the statement . . .

that the use of the Hetch Hetchy as an impounding reservoir . . . would exclude from its watershed tourists and campers, now or in the future, *or lessen the pleasure to be found within the limits of the Yosemite reservation*" (p. 52). The italicized part of the statement has already been disproved under paragraph (1) in the matter of one very large item of pleasure which will have to be eliminated, although on Mr. Freeman's reasoning it is not altogether clear why. If, as he says, "Any pathogenic germs die in a month or two at the most" in a storage reservoir like Hetch Hetchy, pollution from bathing would be removed as effectively as the danger of chance pollutions arising from the presence of campers in the watershed.

But apparently Mr. Freeman does not himself believe in the laxities of sanitary control he advocates in the case of Hetch Hetchy, for on page 343 he urges as an objection to the McCloud River source that "A single case of 'walking typhoid' on the shores of the river might become a serious element of danger" unless a large storage reservoir or a filtration system were established. (N. B.: Surely the McCloud water can be delivered, as he says the Hetch Hetchy water would be, "into storage reservoirs at Crystal Springs or Lake Chabot, or a projected San Antonio reservoir", p. 344.) Then he cited the case of "*a lake* which serves as the source of water supply to a certain city". Although the lumbermen near the lake, he writes, "are all concentrated in two camps and closely watched, it is found difficult to maintain full and efficient sanitary precautions". Now Hetch Hetchy will not even be a storage reservoir in the sense in which a lake is, for a large river is flowing through it constantly. One expert to whom we stated this difficulty said it would be necessary to lead the surplus flow of the Tuolumne through the reservoir by a channel on the side. Anyone who has seen Hetch Hetchy knows that such a thing is impossible.

In the light of these facts and of Mr. Freeman's expressed fears where they could be used to disparage a rival source of supply, what are we to think of his statement that "camping more than a mile upstream from the head of the reservoir (Hetch Hetchy) can do no possible harm"? (p. 36). Again on page 60 he wants to have campers excluded from the Poopenaut Valley until the twelve miles of aqueduct tunnel have been built from the dam to the intake. A reservoir through which a master stream like the Tuolumne flows will set up currents that will render pollution above the dam almost as dangerous as below. We do not want the City engineers to defer the *discovery* of this fact until it can no longer hurt their case.

On page 33 of the report Mr. Freeman makes the statement that those who have urged the difficulty of a joint use of the Tuolumne watershed for park and water supply purposes "set up a fanciful standard of their own . . . far more rigorous than is in force for drinking water supplies of Boston, New York, Los Angeles, Seattle, Portland (Oregon), Portland (Maine), Glasgow, Manchester, Birmingham, or so far as is known now, any city in the world either with or without filtration works".

This statement is in part totally *erroneous*, in part *misleading*, and in part carries approval of a *high typhoid rate as satisfactory*.

PORTLAND, OREGON: The City of Portland, Oregon, which derives its water supply from Bull Run Lake, absolutely prohibits all residence camping, or sojourning, on any part of the 222 square miles of the Bull Run Timber Reserve. To make this still more drastic, the city caused to be passed by Congress an act providing $500 fine for anyone who shall be caught trespassing on the Reserve. What Mr. Freeman means by his reference to the control of this watershed among others as an illustration of what will satisfy both the City of San Francisco and future visitors to the Tuolumne watershed, we must leave to him for explanation. Proof of the facts here referred to will be found in papers attached as Exhibit B.

It will be observed *that nine years after* the Bull Run Reserve was established as a water supply for the city of Portland it was found desirable to have Congress pass a law excluding "the public from the reserve and fining each trespasser not to exceed $500.00". No permission is ever

given to "visit or camp". If the City should acquire the right to use Hetch Hetchy, will she wait nine years before demanding the exclusion of the public?

SEATTLE: The City of Seattle derives its supply from the Cedar River watershed. Mr. Freeman refers to the control of this watershed as an illustration that tourists and campers need expect no interference in the Tuolumne watershed. But the *attached Exhibit C* shows that the city is "allowing no habitation or industrial camp to exist in the watershed of any kind or character excepting those doing municipal work and one or two camps which under the condemnation award were allowed to finish logging certain lands". While the latter continue every workman before he is engaged is examined for typhoid and required to submit to typhoid immunization by a physician representing the City's Health Department. The watershed now "is almost free from human life other than above", and the purpose is to keep it so. Tourists and campers, of course, are neither wanted nor permitted, for under Ordinance No. 27534 (copy appended), it is declared "unlawful for any person or persons to camp, picnic, loiter, trespass, fish, or otherwise be within the Cedar River watershed". Mr. Freeman's assurance that prospective users of the Tuolumne watershed of the Yosemite National Park need not fear anything more rigorous than that is certainly not lacking in grim humor, although his argument may be said to have committed suicide. Cf. Exhibit C.

LOS ANGELES: In the case of Los Angeles, the new water supply is naturally filtered by being passed through the gravels of the Los Angeles River, after being brought from the mountains, and therefore the question of watershed does not arise.

BOSTON AND NEW YORK: *Misleading.* It has already been pointed out that the limited roadway use of parts of New York's and Boston's water supply system is in no sense a parallel to the present use of Yosemite National Park. In the former case, under the most careful policing, there is no camping and no access to the water. If the rules in force on the Croton watershed were applied to the Tuolumne watershed, it would practically prohibit further use of it by camping parties.

But Mr. Freeman must be aware that conditions in New York and Boston are the result of a growing water system in a densely populated area, and that they are far from ideal. The eminent expert, Thos. Blair, in his recent work on Public Hygiene, says: "I am positively of the opinion that to rely wholly upon a well-managed watershed in a populous state to supply safe water is bad policy and dangerous. Probably nowhere else is a watershed so well policed as is the one supplying New York City, and yet the typhoid rate there is almost constantly higher than it should be." In Boston matters are worse. During the period from 1890-1896 (Hill, Water Supplies) the typhoid rate reached an average of 32.6 per hundred thousand. Since then there has been improvement through stricter policing, but the typhoid rate still is too high. Mr. Freeman has admirably exposed the cause of it in the pictures which he published in his report. They are intended to catch the uninformed, but are really a warning to the judicious. Rochester, which he mentions also as making a satisfactory joint use of the watershed of Hemlock Lake, had an epidemic in 1910 resulting in 160 typhoid cases in a few months. Nevertheless its sanitary control is far stricter than what Mr. Freeman advocates for Hetch Hetchy.

IMPLIED APPROVAL OF UNSATISFACTORY SANITATION

Under this head should be classified Mr. Freeman's citation of Glasgow and Manchester as examples of a lax sanitary control that is satisfactory. One only needs to add that their typhoid rates have kept them in the third and fourth class, where cities like Berlin, Hamburg, Zurich, London, Edinburgh and dozens of others are in the first. Two years ago when one of the writers was in England and talked with experts about this very matter, they said that habitation on the watersheds of Lake Katrine and Thirlmere would have to be limited and more rigidly supervised

or filtration would have to be resorted to. Here, also, Mr. Freeman is unfortunate in his illustrations which prove too much, for they illustrate only what should not be done in the case of an unfiltered water supply.

There has not been time to obtain data about other cities mentioned in the report. But there is no reason to suppose that the statements made about the management of their water supplies are any more accurate than they have been found to be in the case of Portland and Seattle.

. . . . . .

INCREASED FUTURE TRAVEL

The statement frequently made in the report to the effect that the Hetch Hetchy Valley and the Tuolumne watershed are accessible only three or four months in the year has an important bearing upon the question of sanitation.

. . . . . .

Questions of sanitation will have to be considered in the light of the enormously increased numbers of people who will visit this region in years to come. Our opponents claim recognition for the virtuous necessity of providing against municipal needs that may arise in a distant future, but do not compare these putative future needs with the equally enlarged recreational needs of a great California and a greater nation. They very illogically compare their inflated population with the few people who, they say, now visit the Valley. As a matter of fact, from thirteen to fifteen thousand persons have annually visited the Park during the last few years, and a very large number of these have gone into the Tuolumne watershed. These constantly increasing numbers of visitors will reach the future of a hundred thousand annually before San Francisco has a population of a million. Many thousands of these will visit the Tuolumne watershed. The recreational needs of these persons, as well as the effect of their visits upon the hygiene of the water supply, will have to be considered now. A project is on hand for the rehabilitation of the Tioga Road for automobile use. If the money can be raised to put the Big Oak Flat and the Tioga roads in good order it takes little imagination to figure out what countless thousands will visit Hetch Hetchy Valley as a side excursion and then pass out over the Tioga Road.

. . . . . .

For many persons the climate of California, from the Sacramento Valley southward, demands for its complete salubriousness the stimulus of ready access to snow altitudes. Therefore, the number of those who in summer visit the National Park for the scenery will in winter be increased by those who go for their health, for the sports, and for the novelty of those winter scenes that never visit a sea-level Californian among his ever-blooming roses.

Judging by the trend of outdoor sports in other parts of the world, this winter use of the Park will in the near future reinforce the summer use as surely as morning succeeds night. Even the present rate of increase in winter visitors indicates that from thirty to fifty thousand people will knock at the portals of Yosemite National Park in the winter of 1930, if facilities of access are provided.

. . . . . .

Respectfully submitted,

(Signed) WILLIAM FREDERIC BADE,
JOSEPH N. LECONTE,
E. T. PARSONS.

ATTEST: JOHN MUIR,
President,
WM. E. COLBY,
Secretary, of Sierra Club.

EXHIBIT A

ACTS OF CONGRESS

July 19, 1892. 27 Stat. 235.

Right of way granted to Co. of Mariposa on that portion of the "*Yosemite National Park*", in said State, commencing "near the southwest corner of said national park as now established, etc.".

July 1, 1898. 30 Stat. 624.

Appropriation for "Improvement of the *Yosemite National Park*. For protection of the Yosemite National Park, etc."

Mar. 3, 1899. 30 Stat. 1100.

"Improvement of *Yosemite National Park*. For the protection of the Yosemite National Park" also provides for the appointment of a commission to examine certain roads "all in and about the Yosemite National Park", also as to a proposed "wagon road to *Hetch Hetchy Valley in said park*".

Jan. 6, 1900. 31 Stat. 618.

"Improvement of the *Yosemite National Park*. For the protection of the Yosemite National Park," etc., also the Secretary of War, upon the request of the Secretary of the Interior, is hereafter authorized and directed to make the necessary detail of troops to prevent trespassers or intruders from entering . . . the *Yosemite National Park, etc.*, for the purpose of destroying the objects of curiosity therein . . . and to remove such persons from said Parks if found therein.

Mar. 3, 1905. 33 Stat. 1286.

Appropriations for the improvement of the Yosemite National Park. 32 Stat. 456, 11, 19. Ditto.

Apr. 28, 1904. 32 Stat. 487.

Secretary of the Interior directed to examine conditions and situations in the United States *Yosemite Park* in the State of California for the purpose of ascertaining what portions of said *park* are not necessary for *park purposes* but can be returned to the PUBLIC DOMAIN . . .

33 Stat. 1188. Appropriation.
Yosemite National Park.

Mar. 3, 1901. 31 Stat. 1162.

Appropriation "for the management, protection and improvement of the *Yosemite National Park.*"

Feb. 7, 1905. 33 Stat. 702.

Segregates certain lands from Yosemite National Park and makes them a part of the Sierra Forest Reserve.

(If already only a forest reserve, what need of transfer?)

EXHIBIT B

Act of April 28, 1904—33 Stat. 526, Chapter 1774.

BE IT ENACTED BY THE SENATE AND HOUSE OF REPRESENTATIVES OF THE UNITED STATES OF AMERICA IN CONGRESS ASSEMBLED, That from and after the date of the passage of this act it shall be unlawful for any person or persons, except forest rangers and other persons employed by the United States to protect the forest, and Federal and State officers in the discharge of their duties, and the employees of the water board of the City of Portland, State of Oregon, to enter, for the purpose of grazing stock, upon any part of the reserve known as the Bull Run Forest Reserve, in the Cascade Mountains, in the State of Oregon, which reserve was established by proclamation of the President of the United States in eighteen hundred and ninety-two, as provided by section twenty-four of an Act of Congress entitled "An Act to repeal timber-culture laws, and for other purposes", approved March third, eighteen hundred and ninety-one, and which reserve includes within its area the water supply of the City of Portland, State of Oregon, and any person or persons, save those hereinbefore excepted, who shall engage in grazing stock, or who shall permit stock of any kind to graze within said Bull Run Forest Reserve or *who shall knowingly trespass thereon,* shall be deemed guilty of a misdemeanor, and on conviction thereof in the district court of the United States for the district of Oregon shall be fined not to exceed five hundred dollars, in the discretion of the court. And the Secretary of the Interior is hereby authorized and directed to enforce the provisions of this Act by all proper means at his command, and to exclude from said forest reserve stock of all kinds and all persons, save as hereinbefore excepted.

Approved, April 28, 1904.

EXHIBIT C

ORDINANCE NO. 27534

AN ORDINANCE amending section 1 of Ordinance No. 19061, entitled "An Ordinance providing for the protection of the water supply of the City of Seattle from pollution, and providing penalties for violation of the provisions of this ordinance," approved August 25, 1908, for the purpose of providing additional safeguards and protection to the water supply.

BE IT ORDAINED BY THE CITY OF SEATTLE AS FOLLOWS:

Section 1. That section 1 of Ordinance No. 19061, entitled "An Ordinance providing for the protection of the water supply of the City of Seattle from pollution, and providing penalties for violation of the provisions of this ordinance," approved August 25, 1908, be and the same is hereby amended to read as follows:

Section 1. For the purpose of protecting the water supply of the City of Seattle from pollution, it is hereby declared unlawful for any person or persons to camp, picnic, loiter, trespass, fish or otherwise be within the Cedar River Watershed, from which the City obtains its water supply, unless they are there performing municipal work, or have been authorized to go upon said grounds or waters legally, or by permission of the Commissioner of Health, or for any person or persons, whether or not they are performing municipal work, or have been authorized to go upon said grounds or waters legally or by permission of the Commissioner of Health, as above provided, to deposit within said Cedar River Watershed any human excrement or other substance whatever deleterious to health, or to commit any act whatsoever tending to pollute the waters in said watershed.

Section 2. This Ordinance shall take effect after its passage and approval, if approved by the Mayor, otherwise it shall take effect at the time it shall become a law under the provisions of the City Charter.

Passed the City Council the 3rd day of July, 1911, and signed by me in open session in authentication of its passage this 3rd day of July, 1911.

MAX WARDELL,
Pres. City Council.

Published July 10, 1911.

GEO. W. WILLING,
Mayor.

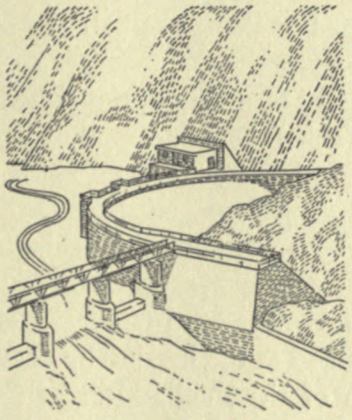
EXHIBIT D

(*Science*, April 15, 1910, pages 578-579)

AIR CURRENTS IN MOUNTAIN VALLEYS

No doubt intimately related to the rhythmic reversals of the lengthwise air current is the period of placidity of Mirror Lake. The surprised and usually vexed tourist, who finds he must get up an hour before sunrise if he wishes to see the mirror at its best, little suspects that what he has undertaken to do really amounts to keeping an appointment with the early-morning reversal of the air current, and that punctuality on his part is vital because of the almost momentary briefness of the phenomenon. Yet such is actually the case. The stillness of the water surface sets in as the down valley draft dies out; but as soon as a sufficient amount of cliff surface has been isolated in Tenaya Canon, the upward movement becomes general, and a faint tremor once more steals over the lake. That its placidity is less perfect with the afternoon reversal is probably due to the relative suddenness with which that reversal takes place and the almost immediate strength of the downward currents in a narrow steep-walled chasm like Tenaya Canon.

F. E. MATTHES, *U. S. G. S.*



CHAPTER IV

Hetch Hetchy in Washington (1912)

ON THE first of September, 1912, Mr. Freeman had prepared and printed a voluminous book, "The Hetch Hetchy Water Supply for San Francisco, 1912," of 401 pages, which included a review of the whole project from the Sierra Nevada Mountains to San Francisco, and containing maps, diagrams, and cost estimates. The object of the book was to condense all information for presentation to the Board of Army Engineers bearing on the physical features of the project, also to make accurate deductions and estimates as to the water productiveness of the Spring Valley water system. Many engineering assistants were availed of by Mr. Freeman to prepare this data, including J. H. Dockweiler, who was consultant for the City Attorney, Percy V. Long; Cyril Williams, Jr., and many other engineers, including Allen Hazen and Horace Ropes.

This book of Mr. Freeman's has been conceded by all engineers to be one of the ablest brief documents ever prepared for this purpose and a copy was presented to each United States Congressman and Senator, so that Hetch Hetchy was pretty well advertised in Washington.

The Spring Valley Water Company was not idle, as its engineers prepared a similar rebuttal volume of 506 pages, compiled by 16 engineers. General H. H. Chittenden predicted that Spring Valley was capable of developing 219½ million gallons daily of water; Mr. Hermann Schussler, then Chief Engineer of Spring Valley Water Company, estimated 231 million gallons daily. Those claims were grossly exaggerated, as since the development of the Calaveras Dam the Spring Valley Water Company has not been capable of yielding over 60 million gallons daily, but those claims were sufficient to cloud the issues and confuse the minds of the legislative authorities in Washington.

The Army Engineers, in a report filed February 19, 1913, estimated that Spring Valley could only be developed to about one-half the scope proposed by the company at an expenditure of $10,000,000.

The Army Board was assisted by a very distinguished Civil Engineer in private life, Mr. H. H. Wadsworth, who aided them in compiling an extremely valuable, authentic, 51-page report, which comprised the data from which the conclusive findings by the Board were framed.

The first preliminary skirmish was held in Washington at the Interior Department, before Secretary Fisher, commencing Monday, November 25, 1912, and lasting until the late hours of Saturday, November 30, 1912.

San Francisco was represented at the hearing by Mayor Rolph; Supervisor Alexander T. Vogelsang, Chairman of the Public Utilities Committee; John S. Dunnigan, Clerk of the Board of Supervisors; M. M. O'Shaughnessy, City Engineer; Percy V. Long, City Attorney; John F. English and Tom Hayden, Assistant City Attorneys; John R. Freeman, Consulting Engineer; Allen Hazen and Cyril Williams, Jr., Assis-

tant Engineers; in addition, there was the Engineer representing the City of Oakland, J. H. Dockweiler; Charles A. Beardsley, Deputy City Attorney of Oakland; also E. J. McCutcheon, Chief Counsel representing the Spring Valley Water Company, with Hermann Schussler, Consulting Engineer; Fred. Herrmann, Chief Engineer of Spring Valley, and George Anderson of Denver, Special Engineer for Spring Valley Water Company.

The irrigationists were represented by their counsel—Pat Griffin, representing Turlock, and Judge Fulkerth, representing Modesto, with a corps of their Irrigation Directors from both districts.

The nature lovers were represented by Underwood Johnson, Editor of Century, and letters from John Muir.

Mr. Freeman was the leading witness for the City and, with all the data fresh in his mind from his recent book, he made a magnificent presentation of the City's application.

The Army Engineers also were observing listeners and rather reticent, as their report was not yet finally prepared.

In the final stage of the proceedings, Mr. Fisher asked me what the area of land to be submerged fully in the Hetch Hetchy Valley would be and I could not tell him. He asked me the reason why and I told him we were not allowed to survey lines or cut brush. He thereupon issued an imperative order to Colonel Forsyth to permit us immediately to make surveys not only in Hetch Hetchy Valley but along the projected Freeman aqueduct leading therefrom through the National Park, and on Saturday, November 30, 1912, I sent an imperative 100-word nightletter to Mr. Loren Hunt to immediately start the City's engineers in the field to make the necessary surveys in Hetch Hetchy and along the route of the aqueduct out of it, to obtain the precise data needed by Mr. Fisher.

The month previous I had an unpleasant experience with Colonel Forsyth, in charge of Yosemite National Park, when I offered to lay a heavy telephone wire connecting our camps with the outside world, when Colonel Forsyth replied that the United States is not going into partnership with anybody and he would not allow the wire to be laid by the City. Since that date other agencies of the United States have manifested a more friendly disposition, as they are now only too eager to get City funds to build roads and boulevards through the Park.

Mr. Fisher cross-examined some of the nature lovers to get their state of mind and the most amusing contact was with Mr. Underwood Johnson, late Editor of the Century magazine. President Roosevelt jocularly christened him "Underbrush Johnson", much to the amusement of President Taft, who rolled his then big fat sides in laughter at his predecessor's pleasantry.

At a critical stage Mr. Fisher asked Mr. Johnson what San Francisco and its women and children would do for water if they were deprived of Hetch Hetchy and other available sources, and Mr. Johnson dramatically replied, rather than cut one tree or break one rock in Hetch Hetchy Valley and spoil the natural scenery he would have

San Francisco condense the water of the Pacific Ocean. Not being a mechanic or scientist he did not know that each thousand gallons condensed from the Pacific Ocean sea water would cost about $2.50 and make the cost of water prohibitive and impossible.

This startling admission practically threw those gentlemen out of court and neither Secretary Fisher nor the succeeding Congressional Committee had much real sympathy for them.

Every watershed in California from Mount Shasta to Merced was explored and studied and plans made for pipe lines to San Francisco on possible alternative sources. More work remained to be done on the McCloud River and Secretary Fisher gave us orders to prepare and submit further data to the Army Board on this branch of the subject and when I returned to San Francisco about the 10th of December, 1912, I had to organize another engineering party to prepare data for a survey from the McCloud River clean down through the Sacramento Valley, crossing the Straits of Carquinez, proceeding down to Niles and crossing the Bay at Dumbarton, and make an estimate of the cost of such a project.

All of those engineering excursions developed a great lot of technical information as to the characteristics of the different streams in the watersheds of California but were of no practical value to the citizens of San Francisco in procuring a water supply. But the judge was friendly and imposed on us the duty of presenting a defense of the City's attitude and wisdom in making a permanent selection for our future source of water supply.

Mr. Fisher showed the friendliest attitude to me personally and I was not a little surprised when, in January, 1913, he commissioned me with Mr. Maltby to review the conflict over the water controversy of Lake Tahoe as a special commission to investigate all the facts, and we held a hearing in San Francisco lasting three days, when all the controversialists having a hand in the disposal of Lake Tahoe presented their different arguments before us,—first, the riparian owners around the lake whose properties were affected by lowering of the levels; second, the Reclamation Service, who wanted to make a dam below the lake to raise the water six feet; and third, the irrigationists and power companies who would also like the lake control. After an exhaustive hearing, in which lawyers argued the case before us, we came to the decision, with the wisdom of Solomon, of making a recommendation to balance the water levels by splitting the difference between conflicting claimants for a height of four feet, which appeared to be very satisfactory to the Secretary.

On January 18, 1913, I addressed the following letter to Mr. Fisher:

Honorable Walter L. Fisher,
Secretary of the Interior,
Washington, D. C.

San Francisco, January 18, 1913.

My Dear Mr. Fisher: I take the liberty of addressing you unofficially to give some description of the work the City officials have done since the hearing in Washington to endeavor to meet your views and those of the many other parties interested in the application of the City of San Francisco for flooding rights in the Hetch Hetchy Valley.

Now, considering the short time before the termination of your present term of office and the deluge of matters which you doubtless have to attend to, I will endeavor to be as brief as possible.

First: A complete and careful reconnaissance and very close estimates of the McCloud have been made and delivered to the Army Board.

Second: Mr. Vogelsang and Mr. Murphy, two members of the Public Utilities Committee of the Board of Supervisors, both lawyers, the City Attorney's office and myself have labored with the form of permit and explanatory letter which have been sent you. I hope those documents will meet with your approval. While personally, as an engineer, I feel that they contain more language than I like to see in public instruments, I presume, however, that this is a natural infirmity from which lawyers cannot wean themselves.

Third: You will notice that I have redeemed my pledge to you at the last evening of the hearing, and that all maps and surveys have been properly prepared to comply with the technical requirements of the Land Department. In the short time at our disposal this has entailed long hours and extra labor on the part of my staff, but the desire for the Hetch Hetchy water system is so strong around the Bay of San Francisco that all citizens will strain an effort by doing extra work to get this desirable and necessary project under way.

Fourth: You will notice that we have respected your suggestion to consider well the application of the farmers and irrigationists for storage water, as requested by you at the hearing in Washington. If you remember, at the time I requested that you grant us opportunity to reflect over the matter. We have done so and I believe have met their demands generously and fairly by making extra storage so that there will be surplus water for them when they need it, at a fair compensation similar to what they have already agreed to pay the Yosemite Power Company for water from the south branch of the Tuolumne. Please do not take our attitude in this matter as being in any way adverse to the strong opinions held by Mr. Freeman as to the undesirability of any relations whatever with the farmers, as we believe he is acting from a thoroughly conscientious standpoint, and fully believes in the correctness of the opinion which he possesses on this subject. Engineers, like lawyers, sometimes differ as well as make mistakes, and I am conscientiously of the opinion that in making this extra provision for storage and receiving an equitable compensation therefor, that the interests of the City of San Francisco will not be jeopardized. Our prosperity and the prosperity of the farming community which are our support are intimately related.

Fifth: Power. You will notice we have made the very broadest provisions for the disposal of any power which may be developed along the lines of the conduit and that we are perfectly willing for any future Secretary of the Interior or the Reclamation Service to act as a referee and final judge, or any Federal, State or other rate-fixing commission to fix the compensation for power possibilities from our structural work. It is only equitable, however, to bear in mind that compensation we should receive for the electrical product should be measured by the outlay made in creating the dams, conduits and other physical structures from the sources down to the points where power is created.

Sixth: Spring Valley Water Company. You can rest assured that the majority of the citizens of San Francisco are perfectly willing to deal with the present Spring Valley Water Company in a fair manner, and negotiations are very near the point of conclusion between the City and that Company. In all such controversies there are radical and obstinate people in both camps who make the situation difficult, but I can assure you that it is the disposition of the City, whether they get the Hetch Hetchy permit or whether they do not get it, is going to be fair toward the present

owners of our water supply. In spite of the maze of literature submitted by the Spring Valley Water Company, and their statements, that the minimum draft from Alameda Creek, by Mr. McCutcheon, was 17 million gallons daily, during the months of November and December, of 1912, from their own published records which you can have confirmed by wire request from that Company, this output was eight million gallons daily. This in face of the fact that they have submitted estimates of cost of bringing in 120 million gallons daily from this inadequate source.

In conclusion, I wish to express my appreciation of your courtesy extended the City officials during the hearing, and my conviction that, personally, no matter what your decision is, I believe it is going to be a fair one as you see it. I do sincerely hope, as one who has assisted in conquering the desert in Hawaii and other places and developing water projects, that you will put nothing in the way which will stop the development of this project, which is required for the development and prosperity of San Francisco, and you can rest assured that nothing the City will ever do will prevent in any way the enjoyment by all the citizens of the United States, who desire an outing in such a region, practically the fullest freedom in the Yosemite National Park.

With congratulations to you on the great and statesmanlike manner in which you have handled your Department in the midst of many conflicting interests, and regret that the public is to lose your services, I beg to remain with respect,

Very faithfully yours,

(Signed) M. M. O'SHAUGHNESSY,
City Engineer.

MMO'S/AMO

CHAPTER V

Hetch Hetchy in Washington Before Congress (1913)

IN MAY, 1913, John S. Dunnigan, City Clerk, was instructed by the Mayor and Board of Supervisors to proceed to Washington to endeavor to get a bill framed granting the City of San Francisco congressional rights to develop Hetch Hetchy. Mr. Dunnigan was particularly well fitted for this mission, as he had previous extensive experience in Washington as correspondent for the Hearst papers and had an intimate acquaintance with all the older Senators and Congressmen.

The first of March previously, President Taft surrendered office, as also did Walter L. Fisher; they were succeeded by President Wilson with Franklin K. Lane as the new Secretary of the Interior.

In the end of February, 1913, I made a special trip to Washington at the request of Mayor Rolph to see Secretary Fisher to try and influence him to render a decision in favor of San Francisco. When I arrived in Washington, February 28th, I called on Secretary Fisher and found that his decision was not yet rendered. On Monday, the 3rd of March, I was again invited to call on him and found his decision in print, which practically straddled a chalk line, so to speak (so far as the application of San Francisco was concerned), not wobbling his views to one side of the question or the other. I asked his secretary for a dozen copies of the report and Mr. Fisher jocosely asked if I wanted so many copies to place in the waste basket, to which I replied, "There is where I think they belong."

He told me pleasantly that when we got our new Secretary of the Interior we would have Franklin K. Lane, former City Attorney of San Francisco, who undoubtedly would be our friend.

On June 8th I again left San Francisco for Washington with the Honorable Percy V. Long, City Attorney, to assist Mr. Dunnigan in the presentation of our case before Congress, and on June 25th we had our first hearing before the House Committee on Public Lands—Scott Ferris, Oklahoma (Chairman); James M. Graham, Illinois; Edward T. Taylor, Colorado; John E. Raker, California; Horatio C. Claypool, Ohio; Harvey B. Fergusson, New Mexico; Carl Hayden, Arizona; Samuel M. Taylor, Arkansas; Lathrop Brown, New York; Tom Stout, Montana; Perl D. Decker, Missouri; Andrew R. Brodbeck, Pennsylvania; Denver S. Church, California; Irvine L. Lenroot, Wisconsin; Burton L. French, Idaho; William L. LaFollette, Washington; William Kent, California; Nicholas J. Sinnott, Oregon; Jacob Johnson, Utah; Charles M. Thomson, Illinois; James Wickersham, Alaska; D. Cameron Campbell, Clerk.

Those hearings lasted intermittently until July 7th, during which time various men were examined by the Committee, including the Honorable Franklin K. Lane, Secretary of the Interior; Honorable Gifford Pinchot, since Governor of Pennsylvania; George Otis Smith, Director of the Geological Survey; Henry S. Graves, Chief Forester; Colonel John Biddle, Corps of Engineers; Percy V. Long, City Attorney of

San Francisco; M. M. O'Shaughnessy, City Engineer of San Francisco; Honorable James D. Phelan, San Francisco; Honorable John I. Nolan, Congressman from San Francisco, and the Honorable William Denman, attorney of San Francisco. On the opposition side against the measure were Mr. Whitman, lawyer of Boston; Eugene J. Sullivan, who represented the Sierra Blue Lakes Water & Power Company, a fake water company, and Mr. Edward T. Cahill.

A most notable display of our needs was made by ex-Mayor Phelan, who quoted from a poem of John Hays' "Little Breeches", which described the old fellow who, believing in nothing that was religious or good and having been told after his child recovered that he had wandered away in the woods and was to be restored by the angels, said:

> To restore the life of a little child,
> And to bring him back to his home,
> Is a darn sight better business
> Than loafing 'round the throne.

I became sincerely attached to Congressman James M. Graham, of Springfield, Illinois, Lincoln's own town. He was a distinguished lawyer with a fine public spirit and a well-balanced mind. In the evenings we frequently walked together and generally ended up in an ice cream parlor.

The nature lovers did not put up much of an "anti" battle, as the Congressional Committee was not in a very friendly mood to listen to their opposition.

When the paragraph on the sanitary restrictions was being finally drafted they referred the matter to a committee consisting of myself and Mr. R. B. Marshall, United States Geographer, representing the Park conservationists, who was one of the leaders in 1899 selecting the boundaries of the original Yosemite National Park, a man of high character.

Mr. Marshall and I took the sanitary restrictions, stated in the Freeman report, and from them drafted the clauses in this portion of the Act which were included in the bill. Many of the provisions are taken from the United States Government restrictions controlling forest uses on public lands:

> It is forbidden to place in the waters of Hetch Hetchy Reservoir or Lake Eleanor Reservoir or in any stream leading thereto, or within 300 feet thereof, any human excrement, garbage or other refuse.
>
> No person shall bathe, wash clothes or cooking utensils, or water stock in, or in any way pollute, these reservoirs, or the streams leading thereto within one mile of the reservoirs or the Tuolumne River between Early Intake and Hetch Hetchy Damsite, or the waters entering the river within one mile thereof.

These clauses were regarded as essential for the protection of the purity of the water supply and the women and children of San Francisco, as it is highly improper to have bathers, boatmen, and fishermen polluting a water supply that is subsequently used

by human beings for drinking purposes. Hence I was very highly gratified at this declaration being affirmed by the Committee, approved by Congress, and included in the Act.

The weather was extremely hot in the Washington Committee room in June, 1913, during the hearings, and members of Congress, as well as the witnesses, were permitted to remove their coats and work democratically in their shirt sleeves in the intense heat. The irrigationists did not make much of a showing, other than a statement near the close of the hearing, from Congressman James C. Needham of California, who, on behalf of the districts, withheld opposition to the proposed Act and commented favorably on the fairness of City Attorney Long and myself in presentation of the application on behalf of San Francisco.

The most sensational testimony was by Mr. Sullivan, representing the Blue Lakes, a rival scheme from the Mokelumne River, who made serious accusations against the honor of San Francisco's former City officials; this individual, on cross-examination by the Congressmen, was placed in a very humiliating position and compelled to withdraw his criticisms.

We all stayed at the Hotel Willard, but one day Mr. Long thought he would be particularly nice and invited us to have supper with him in a very famous restaurant, where frogs' legs and other edibles for epicures were obtainable. I was sick of the hotel and restaurant food of Washington and needed a change, and passed my order in for plain ham and eggs, which caused considerable mirth and consternation amongst my less democratic associates, but I was satisfied with the menu as I was longing again, after all the politics, for the smell of the construction camp, from which I was drafted into the City's service.

After the close of the hearings, Mr. Long and I returned to San Francisco, each lighter in weight by about ten pounds after the torrid Washington temperature. We were met on return with a confused public opinion, inspired and propagated by the *Chronicle,* which up to this time had violently opposed all San Francisco's efforts to win Hetch Hetchy and enter into municipal ownership of water supply.

This was a situation anticipated by me before we went East, and as an antidote I had Mr. Ed. Rainey, the Mayor's Secretary, make a formal call with me on the manager of each of the daily papers of San Francisco, including the *Call, Chronicle, Examiner, Post, News,* and *Bulletin,* so that they would render united support through their columns to our Washington mission. San Francisco papers, like its people, are famous for their petty antagonisms, and I sought to check this feeling in this particular case.

We met with a friendly reception from all the editors except Mr. John P. Young of the *Chronicle,* who was influenced by a bump of conceit from his recent visit to the East and his intimacy with Underwood Johnson, editor of *Century Magazine.* He told us of his recent visit to New York and of the hopeless position of our application. I asked him to please reserve the fire of his opposition while the contest was on and lend a helping hand, instead of knocking us and bolstering up the opposition.

Some of our Supervisors were also confused in mind by the propaganda put out and were antagonistic to the water bargains which we had recently made with the irrigationists; among these was Dr. Giannini, brother of a man who had since become a very distinguished national banker. I interviewed the Doctor one day in the City Hall on my return from Washington, in the corridor outside the Supervisors' rooms, and challenged him for his misstatements about the bargain the City Attorney and myself had made in Washington. Dr. Giannini was originally associated with Mr. Manson, my predecessor, in obtaining the Garfield Permit, which also granted the irrigationists rights to build dams in the higher levels above our watershed about San Francisco's proposed reservoir sites and intercept the water, which would undoubtedly have caused serious future complications and would have provoked untold controversies, and he therefore felt partially personally responsible for having placed San Francisco in an undesirable position in our present bargaining with Turlock and Modesto, hence his criticism at any review of his past activities by our amended solution of the problem.

Every item in the bill was previously discussed in the City Hall of San Francisco by the City's engineers, City Attorney Long and Assistant Haven, and especially John F. English and Robt. M. Searls, assistant attorneys, months before the Washington conference. Mr. Searls is one of the most brilliant young water lawyers in the State of California, having served a long apprenticeship with Judge Lindley, who was the leader of the bar on the Pacific Coast on the law of mines and water, and I was extremely pleased and proud to have him afterwards actively associated with me as Special Counsel on the Hetch Hetchy Project. So that every item of the subject included in the bill was carefully and thoroughly previously discussed and approved by the representatives of San Francisco before Mr. Dunnigan took the amended bill back to Washington.

After the close of the presentation, Mr. Long and I returned to San Francisco and Mr. Dunnigan remained vigorously at work on the job at Washington. On August 5, 1913, he succeeded in getting Mr. Raker, of the Committee on Public Lands, to submit a favorable report prepared by Mr. Dunnigan on H. R. 7207, granting the City and County of San Francisco certain rights of way in, over and through certain public lands in the Yosemite National Park and Stanislaus National Forest, and the public land of the State of California, and for other purposes.

Acknowledgment must here be made to the splendid cooperation of the late William Kent, Congressman, a former Alderman of Chicago, who parted from his interests in the East and became a permanent resident and booster for California. He had a fine mind and a generous heart and was most hospitable to San Francisco's delegation as well as to the Congressmen who weathered out the summer temperature in Washington in extending courtesies and hospitalities at his home to the summer work Congressmen, and San Francisco owes him a debt of gratitude.

This bill had the active endorsement of A. W. Jones, Acting Secretary of the Interior, and Honorable David F. Houston, Secretary of Agriculture, the most distinguished member of President Wilson's Cabinet.

Later in the year a hearing was held before the Senate Committee on Public Lands on September 24, 1913, in which Honorable Herbert Parsons of New York City, Mr. Edmund A. Whitman of Boston, Mr. Robert U. Johnson of New York, and Mr. W. C. Lehane, a promoter of California representing the nature lovers, appeared against the bill.

The irrigationists of Modesto, through Mr. Church, sent the following telegram in favor of Hetch Hetchy:

Modesto, Cal., August 13, 1913.

Denver S. Church,
Washington, D. C.

At a joint meeting of the board of directors of the Modesto and Turlock Irrigation Districts held in Modesto this day, the action of the committee sent to Washington to represent the districts was fully indorsed, and the Raker Bill, as recommended by the House Committee, was approved. The boards also passed resolution requesting our Representatives in Congress to use their best efforts to pass such bill and oppose the passage of any bill granting San Francisco the Hetch Hetchy which does not contain provisions recognizing and protecting the rights of the districts in the Tuolumne watershed, as provided in the bill.

Stanislaus County Board of Trade passed resolutions on Monday night in effect that no further opposition would be made to the Raker Bill. Some little opposition to the bill had been engendered by persons having special interests outside of the districts and by a few others who feel that the waters of the river should never be taken from the valley. People generally of the irrigation districts believe that under all the circumstances the Raker Bill should be adopted without material amendment and that the strongest opposition should be made to any change in the bill which would eliminate any of the conditions in favor of the districts.

C. S. Abbott,
Secretary, Joint Meeting of Directors,
Modesto and Turlock Irrigation Districts.

P. H. Griffin,
Attorney, Turlock Irrigation District.

E. R. Jones,
Attorney, Modesto Irrigation District.

L. W. Fulkerth.

Mr. William Kent presented a statement in favor of the bill; Mr. Alexander T. Vogelsang, Supervisor of San Francisco, and Mr. John R. Freeman of Boston, who had just returned from a European trip, which practically ended the Senate hearings and favorable recommendations from both bodies went to the Congress, which passed the bill. On December 7, 1913, I wired back from Washington to my wife, "Victory at midnight. San Francisco knows how. Love to all."

President Wilson, who was importuned by nature lovers to veto the bill, on December 19th approved it in the following statement:

> I have signed this bill because it seemed to serve the pressing public needs of the region concerned better than they could be served in any other way and yet did not impair the usefulness or materially detract from the beauty of the public domain.
>
> The bill was opposed by so many public-spirited men, thoughtful of the interests of the people and of fine conscience in every matter of public concern, that I have naturally sought to scrutinize it very closely.
>
> I take the liberty of thinking that their fears and objections were not well founded. I believe the bill to be, on the whole, in the public interest, and I am the less uncertain in that judgment because I find it concurred in by men whose energies have been devoted to conservation and the safeguarding of the people's interests, and many of whom, besides, had a long experience in the public service which has made them circumspect in forming an opinion on such matters.

Our relations since then with the irrigationists of Turlock and Modesto have been more than friendly. We got our large dam at Hetch Hetchy, 343 feet high, temporary crest 3726.5 feet above the sea, finished in 1923, designated in my honor by Resolution 20950, Board of Supervisors, March 26, 1923, the O'Shaughnessy Dam. In 1924 we had a surplus of water behind it which the irrigationists of Turlock and Modesto badly needed, and as our power house was not yet ready the water had little commercial value to us for any purpose. However, at the request of the districts, we then sold them 150,000 acre feet of water at the price of $1.50 per acre foot, the proceeds from the sale of which went to help towards the cost of the project. Since that date the joint districts have built a large dam 280 feet high, crest elevation 604 feet, at Don Pedro, the reservoir forming a lake seven miles long, holding 280,000 acre feet of water when full. During the past dry year 1928-1929 of light runoff, much water did not come down the Tuolumne River, so that the Don Pedro Reservoir, on the first of August, 1929, was only partially filled, and again the Modesto District was confronted with a shortage while there was an abundance of water (over 150,000 acre feet), more than 90 per cent the property of Turlock Irrigation District, in the Don Pedro Reservoir, jointly owned by Turlock and Modesto. After having an interview with myself and the present City Attorney, John J. O'Toole, we made a recommendation, which was approved by the Mayor and Supervisors, that Turlock release a part of its stored waters to Modesto to the extent of 46,500 acre feet, San Francisco compensating Turlock at the rate of $19,500 for that volume of water.

San Francisco was handicapped by its California Senators. Senator Perkins was very friendly but old and feeble. He, however, did his best to bring into line some of the old-time Senators long associated with him, like Senator Stevenson of Wisconsin, in favor of the bill, so that his quiet influence in our favor from his long contact with Washington was a very substantial benefit. Senator Thomas of Colorado, Senator Walsh

of Montana, fighting Senators, were also efficient lawyers and earnest advocates of San Francisco's demand for a water supply.

The most vicious opposition framed against the bill was promulgated by our own Senator Works of Los Angeles, the other Senator from California, whom many of our citizens in a frivolous mood styled "Spring Valley Water Works". Senator Works professed to object to the bill on constitutional grounds that the United States departmental officials in Washington were transgressing their prerogatives in attempting to prescribe any uses of the waters in the Tuolumne River, as basically the State laws of the State of California are the only authority that has the right to grant the uses of the waters of non-navigable streams of the State. He spoke vociferously for twelve hours against the bill before a vacant Senate without influencing enough votes to defeat it. His conduct in the matter met reproof even in his adopted city of Los Angeles, whose officials were friendly to San Francisco's desires.

Before the bill was finally passed in the United States Senate Chamber in Washington by a vote of 43 for and 25 against, there was considerable acrimonious debate. Young Senator Pitman of Nevada was San Francisco's champion who led the hosts in our favor. He was a young lawyer and considerably mixed up his second feet and acre feet, and just before the session I was coaching with him in the Military Affairs Committee room next the Senate Chamber with two maps, which I had prepared, showing the relative areas of the two irrigation districts of Turlock and Modesto and possible future storage of water in their sheds. He succeeded in getting those two maps on to the floor of the Senate, an unprecedented incident, and used them for diagrams to illustrate his speech, though documents of that kind are usually barred from the debating floor. It was not until midnight, December 6th, that the Hetch Hetchy Bill was passed. There was an anxious crowd from San Francisco and California watching intently in the strangers' galleries. Ray Baker, who occupied a post in Washington as Director of the Mint, and was subsequently married to Miss Vanderbilt, rendered yeoman service favorably preparing the minds of doubting Senators and doing other work to help our measure. Senator Pitman was a native of Mississippi and as a boy came west. He was a protege of John Sharp Williams, distinguished Senator from that State, who took quite an interest in the presentation of this bill by the Junior Senator Pitman and gazed admiringly at him during the period of his speech like an anxious grandfather.

Senator Martine of New Jersey, who was usually quite amiable, through the influence of his wife, who was created a Vice-President of the National Parks Protective Association by the politicians of that body, was violently opposed to San Francisco, and had an "anti" speech prepared on loose-leaf paper and placed on his desk, to orate against us. An overzealous page succeeded in placing this speech in the waste-paper basket, so that when the Senator proceeded to look for it and did not find it, he was extremely embarrassed and had to subside, being practically destitute of other data.

Senator Phelan was present with the rest of us in the gallery, and after the vote we all adjourned, with Mayor Rolph, to the Willard Hotel to wet our whistles, but the

hour was after 12 o'clock Saturday night—the bar dry—and the only thing we could drink was Washington cold water, and we had the extreme pleasure also of seeing Senator Martine, who adjourned to the same place, compelled to indulge in the same exhilarating liquid.

Percy V. Long, with the aid of Robert M. Searls, prepared a brief on the Hetch Hetchy grant in September, 1913, and succeeded in getting the attorneys for Oakland, Berkeley, Piedmont, Alameda, San Mateo, Redwood City, Burlingame, Palo Alto, Hayward and San Leandro, representing all the bay cities, to sign and endorse San Francisco's application.

William Randolph Hearst, through his paper, the *San Francisco Examiner*, rendered yeoman service to our cause in his chain of papers throughout the United States. Ned. Hamilton, veteran writer for the *San Francisco Examiner*, was specially sent to Washington as a press representative and helped to get out an extra edition of the *Examiner*, which was placed on the doorstep of every Senator the morning of the day of voting. The artists on the paper outdid themselves with vivid imagination, as they succeeded in building a beautiful esplanade around the bluffs of Hetch Hetchy Lake, with palatial Doric gateways, crowded with autoists and tourists, which was the original conception of Mr. Freeman, but which I very wisely succeeded in eliminating from the scenery and the bill.

On our return home to San Francisco the united delegation had an impromptu luncheon function at the St. Francis Hotel, where sympathetic and friendly addresses were made by the Mayor, Alexander T. Vogelsang, Percy V. Long and myself, to the appreciative assembly.

It was certainly a great victory for the City after a twenty years' battle to acquire the right to develop a proper domestic water supply for the people of San Francisco. Nearly every stream in the State of California is being gradually and persistently appropriated by irrigationists and others so there are very little waste or wild waters available for filing on by cities and towns. So great credit must be given ex-Mayor Phelan for having initiated the effort and to Mayor Rolph and John S. Dunnigan for pressing the legislative measure to a successful conclusion in Washington, and without egotism, to myself and able assistants for advancing the construction factors.

The Secretary of the Interior then had his offices in a hundred-year-old building about half a mile from the Willard Hotel on the way to the Capitol. The sills of the doors were made of sandstone and they were worn out by depressions from the many pilgrims, job-chasers and visitors to a depth of perhaps four inches. The rooms also had a gloomy outlook, so that calling on officeholders in Washington caused a feeling of absolute depression, and I was very glad to be now relieved of the necessity of ever having to protract my stay in that beautiful city again.

On the 17th of January, 1913, shortly after our return from Washington, I gave the following interview to the *San Francisco Examiner*, which broadly described the City's status at the time regarding the power project:

CITY'S STAND ON WATER

City Engineer Tells What Has Been Done on Hetch Hetchy

Supplementing the communication sent to Secretary of the Interior Fisher at Washington by Mayor Rolph, defining the position of San Francisco in acquiring the Hetch Hetchy water system, City Engineer O'Shaughnessy yesterday afternoon gave out the following detailed statement:

The proposed permit very carefully covers all objections raised in Washington by the nature lovers, irrigationists, power concerns and other antagonists of the City's plans.

The Public Utilities Committee of the Board of Supervisors, including Supervisors Vogelsang and Murphy, the attorney for and members on same, the City Attorney's office, including City Attorney Long, Lull and English, and the City Engineer, labored for two or three weeks in endeavoring to make this document cover all rational objections to the City's proposed occupancy of the lands in the Yosemite National Park.

The City, at the present time, owns 700 acres of land in fee, including the damsites and part of the basin of the Hetch Hetchy Valley, and desires the right to submerge the adjoining lands when the dam in the remote future is constructed to its ultimate height of about 300 feet.

This will result in submerging about 1300 acres of government land adjoining the City's property, a very small part of which can be claimed to be used by campers.

To compensate campers for the encroachment on their rights, the City proposes to make various trails and paths to other camping sites in the vicinity, so that they will be amply protected in their full enjoyment of the park for the two or three months' outings for which it may be used by them in the future.

One of the questions brought forth by the Secretary's investigation in Washington was to what use the City was going to make of power.

A proviso in the proposed permit makes it possible, after the City's requirements of 20,000 or 25,000 horsepower are provided for, that all surplus power above this quantity may be disposed of by the City so as to procure an equitable return on the investment in dams, reservoirs and aqueducts above a point at which the power would be created.

This would relieve the City from the expense of going into wholesale power investment, while it would be compensated at the same time for its enterprise in creating the storage dams and making the conduits, while engaged in the development of a domestic water supply.

Every angle of this subject was thoroughly threshed out by the nine representatives of the City at the hearing in Washington, so the Secretary is now fully equipped with information and data to furnish a favorable and equitable decision for the City in this controversy.

The people of the cities around the bay are very much interested in the outcome, as they are prepared to join with San Francisco in the expense of constructing this enterprise.

CHAPTER VI

Progress of Work During 1913-1914— Transportation Road

WITH the passage of the Raker Act and its approval by the President, San Francisco was in a position to proceed with the actual work of construction. Much preliminary work had to be done, and one of the first things was to provide for transportation of materials and supplies. Materials were transported to the Hetch Hetchy Valley and vicinity by the road projected from Hog Ranch in to the damsite. Preliminary surveys for this road were made in October, 1913, and the final location completed in April, May, and June, 1914, by the first engineer employed by me on the Hetch Hetchy Project, C. R. Rankin.

This road was nine miles in length, 22-foot roadbed, with a maximum grade of 4 per cent, and the contract for its construction—the first on the Hetch Hetchy Project—was awarded July 18, 1914, to the Utah Construction Company at an estimated price of $151,499.50.

Betterments were made also on the old wagon trail which followed the ridge past Early Intake, between South Fork and Hog Ranch, so as to make the road available for use in connection with completing the final road in to the damsite at Hetch Hetchy.

Plans were prepared in the City Engineer's office for filing in the Land Office in Washington, showing map of the reservoir sites surrounding Hetch Hetchy, a map of the tunnel aqueduct location between Cherry and Hetch Hetchy Valleys and the west boundary of the Park, also the Cherry Valley Reservoir site, and map of the tunnel aqueduct location inside the Stanislaus National Forest. So 1913-1914 was a busy year on surveys from an engineering point of view.

The City had heretofore spent altogether very nearly a quarter of a million dollars in the employment of engineering experts under John R. Freeman as Chief Consulting Engineer, to prepare the various aspects of the City's case for presentation before the Army Board of Engineers and make preliminary studies of the plans for dams and aqueducts.

I was gratified with Mr. Freeman's expansion of the project from an initial capacity of 60 million gallons a day, as proposed by Messrs. Manson and Grunsky, to one with a capacity of 400 million gallons a day, and approved the splendid vision he displayed in the general location of the aqueduct from the mountains to the San Francisco Bay region.

New York, Chicago, Los Angeles are constantly expanding their water systems. New York's needs increase at the rate of 30 million gallons per day per year. Los Angeles increased at the rate of 10 million. So it was splendid foresight on the part of Mr. Freeman to anticipate our needs to the extent of 400 million gallons daily, which will save the San Francisco of the future from entangling and annoying conflicts in securing and developing additional water supply sources.

I questioned the tentative layout for details of a power plant at Moccasin Creek, proposed by Mr. Freeman, which contemplated making a large inverted and costly concrete conical reservoir or surge shaft at the end of the aqueduct on top of the hill above the power plant, and operating the plant directly connected with a continuous tunnel and pipe twenty miles in length, under full pressure, from Early Intake. This did not appeal to me as a satisfactory solution of the problem, and after giving the matter earnest consideration, I felt convinced I should have the advice of a board of disinterested, independent, California consulting engineers, with broad experience in the design and operation of high head plans in revising this portion of the plan and I immediately took steps to secure the appointment of such a board. I conferred with Thomas Jennings, Chairman of the Finance Committee of the Board of Supervisors, and secured the necessary sanction, and the money was allocated for their compensation.

The personnel of this board of experts was Professor W. F. Durand of Stanford University, a mechanical engineer and eminent in the field of surge pipe design; John D. Galloway, a civil engineer, with many years' experience in the general design and construction of high head power plants, and F. G. Baum, a leading electrical engineer, outstanding in the field of power plant design, operation and transmission problems.

In order to limit the scope of the report and at the same time insure its covering all of the elements of the problem which I considered essential, I addressed a letter to the Engineering Board setting forth fifteen pertinent questions relative to the same which I desired answered. (See letter set forth on pages 56 to 58, inclusive.)

This group of experts spent about two months in compiling a report, the findings of which I thoroughly concurred in, with the exception of their recommendation to reduce the projected size of a 10′ 6″ diameter aqueduct by constructing two parallel tunnels 8′ in diameter in smaller units a number of years apart. This reduction in size of conduit would have resulted in reducing initially the profit from our power output one-half, besides jeopardizing our water rights under the laws of the State of California. On this latter phase of the problem I had the concurrence of our legal advisers, City Attorney Percy V. Long and Judge Curtis Lindley, who told me to ignore that part of the report and proceed with the construction of the larger aqueduct.

The most important and attractive feature of the engineers' report was the substitution of the large Priest forebay reservoir with an 150-foot dam holding two and one-half days' flow of the aqueduct, in place of the conical surge reservoir or tank of concrete of small capacity that Mr. Freeman had proposed.

From my previous experience in building aqueducts in Hawaii, which included about thirty miles of tunnels, I was convinced of the importance of having our aqueduct line all gravity, with a continuous gradient from Early Intake to the Moccasin Power House without the inverted siphon, about 3000 feet long, which Mr. Freeman contemplated installing across South Fork. This change I considered a very decided improvement on the general plan of the aqueduct.

An extract from the report, giving a general description of the power development

as proposed by Mr. Freeman and the elements of the same which the Board considered as fixed and those which they considered as flexible, are noted elsewhere.

This report schematically outlined the position and location of our power plant, around which the mountain features of the project were to be designed and constructed. It was a most valuable contribution to the success of the project and I want to acknowledge the obligation I feel to each of those gentlemen for their part in its success. No serious construction of any kind was attempted until this report was filed.

During the year 1915 we made an exhaustive survey of a railway line to run down on the crest of the ridge from Hetch Hetchy, through South Fork, Smith Station, Groveland and Jacksonville, crossing the Tuolumne River about a mile below and going over the terrace to the Hetch Hetchy Junction on the Sierra Railway, twenty-six miles east of Oakdale. This survey was made also by C. R. Rankin, an experienced railroad locating engineer, and plans and specifications were prepared for grading, and propositions for construction were received by the Board of Public Works on December 5, 1915, the contract—No. 7—being awarded to F. Rolandi in the amount of $1,530,080.74. Due to lack of Hetch Hetchy funds in the City Treasury the contract was not approved by the Auditor until February 15, 1916, when bonds were sold, and on June 30, 1917, there was $1,457,000 spent on this work.

The same ruling grade plan as conceived from Hog Ranch into Hetch Hetchy, with 4 per cent grades and 30 degree maximum curves, was adhered to in the location of the balance of the roadbed, which was a distinct improvement on the pioneer roadway suggested by Mr. Freeman, which involved 6 per cent grades and sharper curves, which would be a roadbed very defective as a freight carrier.

May 4, 1914.

W. F. Durand, Esq.,
John D. Galloway, Esq.,
F. G. Baum, Esq., San Francisco.

Dear Sirs: There is a problem presented in the construction of the proposed Hetch Hetchy project of deciding on the design of the aqueduct from Early Intake and the surge shaft and pressure end of a power installation at Moccasin Creek, which needs solution at the present time, and you are requested by the City of San Francisco to make recommendations on the following features of this problem:

(1) In case the Freeman plan of a pressure tunnel between Early Intake and Moccasin Creek Power House is followed, what should be the dimensions and form of the proposed surge shaft or chamber in order to effectively and at minimum expense provide the necessary safeguard against shocks due to sudden fluctuations in the power house demand and also to secure adequate means for satisfactory speed regulation, having in mind the demands of modern electric service? What in outline should be the design of such structure in order to safely carry the load due to the most severe hydraulic conditions which may arise?

(2) What is the economical limit of the development of the storage or pondage at Early Intake at this time for the purpose of balancing the fluctuating daily demand, considering the progressive development by which the complete storage outlined in the Freeman report will be

obtained within say thirty years? It is now contemplated to depart from the Freeman recommendations by making the Hetch Hetchy Dam initially 300 feet high with 345,000 acre feet capacity.

(3) With the Early Intake developed to its economical pondage limit, what plant capacity should be installed to utilize the water supply, taking into consideration the probable load factor?

(4) The tunnel recommended in the Freeman design is ten feet in diameter on a gradient of two feet per thousand. As a pressure tunnel this will require a surge chamber of such size as may be determined in accordance with question (1).

A pressure tunnel with a lesser gradient and lower velocity will necessarily be larger in size but will reach the power drop at a lesser distance below static level and will, therefore, require less depth of surge chamber. Furthermore, such larger tunnel will entail a reduced loss due to friction and will secure a larger residual head available for power production.

Holding in view the use of a pressure tunnel, is the proposed gradient of two feet per thousand the most economic grade, considering the market value of power, together with the estimated variations in the investment costs of tunnel and surge chamber with changes in size? If not, determine the most economical size.

(5) In the case of a non-pressure tunnel, what should be the amount of forebay capacity, having in mind the maximum rate of load fluctuation in the power house, the relation of average to peak load (load factor) and the time constants of the conduit running as a partially filled tunnel?

(5a) What investment in a forebay reservoir would be justifiable to procure this forebay capacity?

(6) Determine the most economical gradient and tunnel size to deliver 620 cubic feet per second, taking also into consideration any features which may serve to fix the location of forebay.

(7) In case the topography will not permit of forebay capacity at the immediate head of the power drop sufficient to secure full operation on a normal load curve of about 50 per cent factor (thus requiring at peak loads about double the average rate of flow), under what conditions could plans for intermediate storage be developed, what should be the amount of such storage, what limitations must be observed in regard to its distance from the power site, and to what extent will it be necessary to enlarge the size of the conduits between the storage point and the power drop?

(8) In the case of a non-pressure tunnel the inflow of water at the upper end must permit of regulation in accordance with the varying demand at the power house, and, to such extent as may be practicable, in anticipation of such demand, thus reducing the forebay capacity which might be otherwise required. What means may be recommended for such regulation and control, to what extent can it be expected that the general trend of the load changes can be anticipated and regulated, and to what extent can such anticipation be safely counted on as a factor in reducing forebay or storage capacity?

(9) To what extent and under what conditions could the principle of intermediate storage as in (7) be developed and applied in the case of a pressure tunnel and what effect would the existence of such intermediate storage have on the design of other features and especially on the size of the surge chamber at the head of the power drop?

(10) In general, what safeguards should be contemplated in connection with the entire power installation in order to insure fully against danger of shock or injurious pressure in either penstocks or pressure tunnel conduits? What are the relative merits and objections to each?

(11) Consider also the progressive development plan of the City by which complete storage will be obtained in perhaps thirty years, and what economic features should now be considered in arranging size of plant to get the greatest profitable power output from the present proposed development.

(12) In so far as values can be readily estimated and expressed quantitatively, develop an

economic comparison between the pressure and non-pressure types of conduit for the twenty miles under present consideration.

(13) Holding in mind such comparison and including value less amenable to direct quantitative expression, which type of conduit do you recommend as the better adapted, all things considered, to meet the conditions of the problem, and what should be the leading characteristics and dimensions of such conduit and of the necessary auxiliary structures or features of the installation?

(14) Regarding the suggestion or recommendation in the Freeman report on page 61 that the water covered by the priorities and intended for irrigation purposes should be first utilized for power and only released for its ultimate purpose below the power sites, to what extent is this suggested program considered desirable and practicable at the present time?

(15) In what particulars and to what extent will the inclusion of a part or all of such irrigation water in the power program affect the consideration of, or the conclusions reached with regard to any of the preceding questions, (1)-(13)?

Very truly yours,

(Signed) M. M. O'SHAUGHNESSY,
City Engineer.

To this they categorically replied on July 4th as follows:

The specific questions asked by the City Engineer appear under Section 1, and answers are here given in accordance with the numbers of the questions.

(1) The dimensions of the surge chamber are given in Section 3. It is to be noted that the size of tunnel recommended by Mr. Freeman is too small to permit of regulation in accordance with the load factor proposed, or under reasonable operating conditions, and that a surge chamber to fit such a tunnel would be of excessive depth. The surge chamber is eliminated from the recommended design.

(2) No storage for regulation is required at Early Intake in the recommended plan. The storage would be at the lower end in order to allow uniform flow of water through the conduit tunnel. Storage for regulation at Early Intake would require the conduit tunnel to be of large size and excessive cost.

(3) This question is answered partly by (2) and by the body of this report, Section 4, where plant capacity is discussed.

(4) The tunnel of the Freeman design, 10 feet diameter, is not large enough for the power plant if the regulation be that for 65 per cent load factor. The plan of a pressure tunnel of proper size and regulating reservoir at Early Intake is not recommended as the cost is too great. The regulating reservoir should be at the lower end of the conduit.

In the recommended plan, the regulating reservoir is so placed. A favorable site was found near Priest's permitting of the development of ample storage. The surge chamber is eliminated as the regulating reservoir fulfills the requirement better and answers other purposes.

(5) The forebay requirements on the 65 per cent load factor assumed, with the peak load above this factor carried by a steam plant, was 11,000,000 cubic feet with the reservoir at Priest's. Something more than the exact amount is necessary. As proposed, the Priest's regulating reservoir has a capacity of about 87,000,000 cubic feet.

(5a) The exact difference in cost between tunnels was not calculated for the two plans of regulation at Early Intake as contrasted with regulation at Priest's reservoir. Roughly, the difference is about $1,000,000 in favor of the latter plan. The reservoir at Priest's can probably be

built for $300,000 to $400,000, which might represent the additional cost at Early Intake for the same service. In addition, the operating conditions are better as the tunnel is not subject to changing pressures due to surges.

(6) This is answered above and in report, Section 4. If one tunnel is used, the diameter should be 10.5 feet. If two tunnels are used, one being built now, the diameter should be eight feet. Circular sections should be used.

The grade of the tunnel is fixed by the conditions. The lower end is at elevation 2170 feet. The upper end must be as far as possible below the water surface at Early Intake, which is elevation 2340. Working conditions will determine this. The hydraulic grade line starts at elevation 2340 at Early Intake, and drops to average elevation 2218 at Priest's regulating reservoir when $n = .014$ for a tunnel 10.5 feet in diameter and 620 second feet of water is flowing. The tunnel is slightly below this.

(7) Topography permits of a regulating reservoir at Priest's of ample size. See (5). No intermediate storage is necessary nor advised.

(8) As the Priest's regulating reservoir is of ample capacity, the flow in the conduit tunnel is practically uniform. No care is necessary in controlling this flow, as it is automatically regulated by the water elevation at the reservoir, the exit of tunnel being below the water surface. The pool formed by a dam at Early Intake should be sufficient to make uniform any irregularities of the flow of the river or the discharge from the reservoirs, so that the inflow to the tunnel would be at a uniform rate.

(9) The change of plan to a regulating reservoir just above the power house, of ample capacity, makes unnecessary a pressure tunnel, surge chamber and intermediate storage, therefore such design is not discussed.

(10) The recommended design eliminates the pressure tunnel except that the conduit tunnel has the pressure due to being slightly below the hydraulic grade line. The regulating reservoir eliminates all possible pressures due to shock. This could have been effected in the Freeman plan by the surge chamber. The plan for the proposed pressure tunnel on the incline to the power house is rejected as dangerous and without precedent.

From the regulating reservoir the conduit should be pipes, which should be of steel, as the head, when leaving the reservoir, is 140 feet. Ample precedent exists for steel pipes under the head at the power station.

The water wheel nozzles should be of the needle regulating deflecting type. With this type there is no danger of shock to the pipe line due to water surge.

(11) The recommended number of units in the power station is six, and of the pipes, three. This will permit of progressive development of the station. The economic development of the entire plant depends upon the amount of water developed. This relates to the reasonable needs of the cities. If, *as noted in the body of this report, but one-half of the water is developed*, or 310 second feet, then the power plant development should be along the same lines. This would call for a tunnel eight feet in diameter instead of 10.5 feet, with a corresponding saving of investment of $1,500,000. As this smaller tunnel would serve the aqueduct purposes for about forty years, it is recommended that such be used. The interest on the sum saved at 5 per cent compounded for the forty years would amount to $9,000,000, or nearly twice the cost of the second tunnel. An extended discussion of the whole subject is given at the end of Section 4.

(12) The plan of development with a non-pressure tunnel with uniform flow and with the water flowing with a free surface is discussed as Plan No. 3, in Section 3. As compared with Plan No. 2, as recommended, it has the disadvantage of permitting the utilization of a somewhat smaller fraction of the total head, and of being responsive in delivery to changes in the level of the forebay, resulting from varying draft at the power house. It does not, furthermore, offer any

economies in construction, and the pressure type with regulating reservoir is therefore preferred. These general points of advantage for Plan No. 2 seem to render unnecessary any attempt at further detailed comparison.

(13) If consistent with the proper safeguarding of the City's water rights, we recommend a progressive construction, comprising ultimately two tunnels, each eight feet in diameter, the initial stage to comprise one such tunnel, and the second to be added when required by the increasing demand for water.

(14) The irrigation demand for water is greatest from April to August. At this time the mountain streams are carrying the largest proportion of their flow, and hence at this season there is no excess market for such intermittent power. The power that can be sold will be largely measured by what can be delivered from July to January. It is therefore not recommended that the irrigation water be taken into account in designing the plants.

(15) The irrigation water may be used until the City's storage is ample, but after that time the City will have to be practically independent of the irrigation system.

Respectfully submitted,

(Signed) W. F. DURAND,
J. D. GALLOWAY,
F. G. BAUM.

Further discussion by Messrs. Durand, Galloway and Baum.

DESCRIPTION: POWER PLANT NO. I AT MOCCASIN CREEK

This plant is described in the Freeman report as follows:

There is only one power-drop in the aqueduct line first to be constructed. The power house site for this is located very close beside the main highway at Moccasin Creek, six miles easterly from where the aqueduct line crosses the main Tuolumne River, and about 141 miles distant from the City Hall of San Francisco, along the aqueduct line, or 150 miles around the head of the bay.

The aqueduct capacity from the Early Intake down to the power house will be somewhat above 620 cubic feet per second, which is the equivalent of 400 million gallons daily.

The elevation of tailwater at this power house is planned to be 890 feet above mean sea level. The water level at the intake will be 2315 feet, and the gross fall thus 1425 feet.

Under working conditions, the head of the flowing water in the surge shaft at the top of the incline tunnel will be about 2150 feet above sea level, giving a net working fall of approximately 1250 feet when 620 second feet are flowing. With waterwheels of ordinarily good design and efficiency, this head and volume will produce 70,000 mechanical horsepower 24 hours per day, under conditions exceptional for efficiency and low cost of operation.

The tunnel from Early Intake to Moccasin Creek is described in detail on pages 281-282 of the report, from which it is determined that there will be 95,980 lineal feet of tunnel and 1700 feet of pressure pipe across the canyon of the South Fork, making a total length of conduit involved in the power plant design of 97,680 feet. The estimates of cost of the tunnel are found on pages 249, 283, 284 and 300.

FACTORS AND QUANTITIES INVOLVED

For purposes of this report, certain factors are taken as fixed, and others as variable. Of the factors assumed as fixed, mention may be made of the following:

(a) The general location of the plant with water taken from the stream at Early Intake, the tunnel type of waterway through the mountains with pressure pipe crossing the South Fork of the Tuolumne River, and the location of the power plant on Moccasin Creek at the base of Priest's Hill.

(b) The amount of water ultimately to be developed, 400 million gallons per day or an average flow of 620 cubic feet per second.

(c) The population studies and other conclusions of Mr. Freeman as indicating the required rate of development.

(d) In general the various assumptions made by Mr. Freeman in his consideration of the project in its entirety.

Of the factors in the design of the power plant and its relation to the project as a whole, which we have considered as admitting of variation, and in connection with which changes or modifications may be suggested, mention may be made of the following:

(a) Location of the tunnels in so far as slight changes might more effectively adapt them to the requirements of power development.

(b) Form and diameter of tunnel section in accordance with indications of economic study made with special reference to value of power.

(c) Size and number of tunnels, etc., in accordance with indications of economic study made with special reference to the progressive development of the entire power system.

(d) Means to be adopted for securing the necessary regulation between tunnel flow and the water required by the power units and delivered to the tailrace, in accordance with a commercially varying load.

(e) Type or character of pressure conduit or conduits from head of power-drop to power house.

(f) Unit prices in so far as may be deemed advisable.

CHAPTER VII

Spring Valley Water Company

THE subject of acquiring the Spring Valley Water Company has been a source of controversy in San Francisco since 1873, when the first attempt to purchase it was made. At that time the City expressed a serious interest in acquiring the property and, under the chairmanship of Mayor James Otis, brought from Louisville, Kentucky, a distinguished hydraulic engineer named T. R. Scowden to investigate the question of water supply and make a report. He spent a year from August 3, 1874, to July 30, 1875, in making studies for a water supply for San Francisco. His final conclusion and recommendation was that the City buy the Calaveras lands in Santa Clara County of over one thousand acres and the Vallejo Mills property and water rights down Niles Canyon in Alameda County.

In May, 1875, the Special Committee presented the following resolution, declaring it to be expedient and proper to purchase the water, water rights, and property, etc., of the Alameda Water Company:

> Resolved, That it is the opinion of this Board, after a careful and thorough examination and consideration of the report of T. R. Scowden, engineer, on the various sources of water supply, that it is expedient and proper and for the interest of the City and County of San Francisco and her inhabitants to acquire, by purchase, for said City and County, the water works, reservoirs, pipes, flumes, ditches, distributing mains, water rights and real estate owned by the corporation known as the Alameda Water Company, and the real estate connected therewith, with all the water rights, creeks, ponds, springs and sources of supply pertaining thereto, as shown by the reports and surveys filed of T. R. Scowden, engineer of water supply, and owned by said Alameda Water Company. Also, to contract with said corporation to furnish, construct and put in operation the necessary reservoirs, distributing mains, pipes, flumes, tunnels, ditches and machinery to furnish an abundant supply of pure fresh water, as contemplated and provided in an Act of the last Legislature, approved March 30, 1874.
>
> Resolved, That the Committee, consisting of the Mayor, Auditor, and City and County Attorney, be, and is hereby authorized and empowered to view and carefully examine the property hereinbefore mentioned, and to enter into negotiations with the corporation known as the Alameda Water Company, and to contract with and purchase from said corporation their water works, reservoirs, distributing mains, pipes, flumes, ditches and water rights owned and claimed by said corporation, and the real estate connected therewith, and to contract with said corporation to furnish, construct and put in operation the necessary reservoirs, distributing mains, pipes, flumes, tunnels, ditches, and machinery to furnish this City and County and her inhabitants with an abundant supply of pure, fresh water, and report the result to this Board as soon as practicable.

On the 31st of May, 1875, the following communication was presented, read and placed on file:

San Francisco, May 25, 1875.

James H. Deering, Esq.,
Chairman of Committee on Water Supply.

Dear Sir: I would respectfully state, for the information of your Committee, and through them to the Honorable Board of Supervisors of the City and County of San Francisco, that the Alameda Water Company have disposed of their water rights and real property appertaining thereto to the Spring Valley Water Company of San Francisco.

Very respectfully,

C. N. Felton,
President, Alameda Water Company.

This letter at that time ended the quest of San Francisco for obtaining a municipal water supply.

On July 30, 1875, Mayor James Otis, Monroe Ashbury, Auditor, and W. C. Burnett, City and County Attorney, made an attempt to buy the Spring Valley Water Works properties. The Company quoted a price of $14,500,000, which the Mayor declined on the ground that it was in excess of the true cost of the works, as shown by the Company's books, and also in excess of the real value.

The Spring Valley Water Company remained in possession of the source of supply and under the new Constitution of the State of California—1879—the Board of Supervisors had annual spring field days in determining the rate of compensation to be paid for water during the year. In those days there were twelve Supervisors. It was necessary to have nine favorable votes to successfully fix a water rate. After much testimony and oratory by witnesses this rate was satisfactorily determined for the Water Company each year.

The political bosses, Republican and Democratic, selected the Supervisors, and the general decision at each rate hearing was satisfactory both to the bosses and the Water Company. The Supervisors were supposed to receive an honorarium and at one time the stakeholder decamped with the spoils to the East and left his associates empty-handed, anxiously waiting at the rail.

Our new Charter was installed in 1900, the number of Supervisors increased to eighteen, and under the leadership of Mayor Phelan, an active assault was made on the Water Company's rates. Mayor Phelan went further and had surveys made in the High Sierra to get the most desirable source of mountain water supply. He made the original filings on the Tuolumne River. These were disapproved by the Secretary of the Interior Hitchcock, and it was not until Mayor Rolph assumed control of the City in 1912 that we got real action on the Sierra water by putting through Congress the Raker Bill, which gave us primary rights on the Tuolumne River.

On the 24th day of February, 1913, the Board of Supervisors passed Resolution No. 639, requesting the City Engineer to transmit a list of properties belonging to the Spring Valley Water Company, necessary, available, and usable for a source of water

supply for the City. On the 19th of November, 1913, I, as the City Engineer, filed plans and maps indicating the necessary list of these properties to be acquired. On the 31st of December, 1913, the City Attorney, Percy V. Long, filed action in condemnation in the Superior Court of the City and County against those selected properties.

In the meantime the City appointed an Advisory Water Committee, consisting of James Rolph, Jr., Mayor; Matt I. Sullivan, attorney at law; Supervisor Alexander T. Vogelsang, Supervisor Thomas Jennings, Percy V. Long, City Attorney, and M. M. O'Shaughnessy, City Engineer. The City Engineer conferred with the Committee and discussed the purchase of the properties. The Water Company accumulated large areas of land, over 100,000 acres, much of which was for speculative and held for combative purposes against the proposed rival Tevis water scheme. In making his final determination the City Engineer excluded all unnecessary lands, including about 38,000 acres that did not produce water, such as the Coyote Creek lands of 11,977 acres in Santa Clara County, and the Pleasanton Valley lands of 5616 acres.

The Water Company agreed with the City Attorney, as set forth in letter dated July 27, 1914, to sell to the City all these properties selected by the City Engineer for $34,500,000 and additional payments of capital expenditures made by the Company from January 1, 1913, and interest, allowing the City to select such lands as set forth in the City Engineer's recommendations, and with the statement that all of the other tracts of land retained by the Spring Valley Water Company were of no value to San Francisco for water supply purposes, except in certain cases, and in such tracts the water rights appertaining to the land would be conveyed to the City, thus giving to San Francisco all the value that can attach to them as water supply lands.

The gross revenue from water sales in 1913 was $3,322,048.10. It was deemed a wise measure to acquire the properties as the Company owned a monopoly of reservoir sites on the San Mateo Peninsula and its system lent itself admirably to a merging with the completed Hetch Hetchy supply.

Five separate elections were held before San Francisco was able to successfully carry the purchase of this water system, and it was not until May, 1928, that a two-thirds majority was obtained, for a price of $41,000,000, in spite of the opposition of one of our local papers, the *Bulletin*, edited by W. M. Hines, and Adolph Uhl, a private citizen.

The 1929 revenues from the Water Company measure up to $7,000,000 yearly, which will net San Francisco about $1,200,000 annually from public ownership, after paying the bond redemption and all operating expense.

Spring Valley purchase elections:

January 14, 1910	Yes 22,068	No 11,722
April 20, 1915	Yes 39,951	No 33,455
March 8, 1921	Yes 43,073	No 30,992
June 14, 1927	Yes 41,463	No 28,611
May 1, 1928	Yes 82,490	No 21,175

Many controversial debates were indulged in during the discussion of the purchase between 1913 and 1915, in some of which I participated, as illustrated by my discussion of the purchase before the Board of Supervisors in 1913, as follows:

Discussion on
Purchase of Spring Valley Water Company for $37,500,000
Board of Supervisors, San Francisco, 1913

The Mayor, James Rolph, Jr.: Chief, we would be glad to hear from you.

Mr. O'Shaughnessy: Mr. Mayor, and members of the Board of Supervisors: It is rather late in the day to go extensively into this subject. Since I have been appointed a City official I have given a great deal of attention to the growth of the City and its consequent demand for water. Without abundance of water, we cannot grow. Some parts of the City, such as the Richmond section, are in a very deplorable condition at this time. There are now between 40,000 and 50,000 people living in that section, and the same water mains supply them that were installed fifteen years ago, the same supply as when there were only about 3000 people in that section. The same may be said of many other parts of the City, and the condition of the distributing system is simply deplorable. Now, if San Francisco is going to grow, it cannot grow without water. We have practically half a million people at the present time here. There are about five millions of people in the City of New York. At the present time, New York is engaged in extending its water service by adding the Ashokan system at a cost of $183,000,000, distributed over a period of eight years, which means the expenditure of about $23,000,000 or $24,000,000 a year that the City of New York is expending to increase its water supply. San Francisco, with one-tenth of the population, and based on the same ratio, to keep in line, should spend a similar proportion, or at least two and one-half million dollars a year to keep abreast of our requirements. I believe, and I think that nature had so fixed us that we are going to be a great metropolitan city if we only help to make it so. The past history of the water situation here has been recited by many of the members of this Board, and it is a very sad history. Three years ago, when this proposition to purchase all the Spring Valley properties at $35,000,000 was before the people, I then wrote a letter to the Merchants' Association, to the then Chamber of Commerce, and took the stand that the defeat of that purchase was almost as bad for this City as the earthquake or the fire. The defeat of that purchase was made by the attitude of heartless men, with debased political standards, including your late Mayor P. H. McCarthy, who did not understand the subject, but who were just as pronounced and as strong in their convictions against the purchase as those expressions I have just heard from Supervisor Koshland here this evening. I believe that some of them sincerely believed they were right. But no matter what their belief was, their attitude has placed this City in a very bad situation. In the whole United States today there is not one big city of the size of San Francisco that does not own its own water supply. In the United States today, there is no property such as the Richmond section, worth $100 or $125 a front foot, with paved asphalt streets, a park on one side and a Presidio Park on the other, with every advantage to live in, that has no water. Now, there is a great deal of the tactics of the Spring Valley that I do not like. I think there is a great deal about their tactics that this Board is unanimous in disapproving. I think myself their attitude in injecting themselves into this Hetch Hetchy proposition, in opposition to the City, has been extremely foolish. Because, Hetch Hetchy or no Hetch Hetchy, this City ought to acquire the system of the Spring Valley Water Works. Now, to come to the question of price. The price agreed on two years ago, three years ago, the price at which this property was submitted was $35,000,000 for all the properties. Since then this Company has invested about

$2,300,000, principally in acquiring lands over the so-called Livermore-Pleasanton gravel bed, and buying out the water rights of the hop ranch around Pleasanton, so as to practically clear their titles for diversion of underground water, so that it could safely be said that the title to all of their properties from the Calaveras watershed to the Bay of San Francisco, from Livermore down, are entirely clear. And because Mr. Tevis, of the Union Water Company, or any other water company, buys some other piece of land lower down that is not appurtenant to the water or has riparian rights, is no reason why this City should be deterred in assuming any action on this question. I have looked over the records of consumption of water in this City for the past three years and they show a steady growth of about two and a half million gallons of water a day each year.

SUPERVISOR A. J. GALLAGHER: Would you permit an interruption?

MR. O'SHAUGHNESSY: Yes.

SUPERVISOR A. J. GALLAGHER: What is the wastage shown?

MR. O'SHAUGHNESSY: The wastage shown could not be determined without the universal use of meters. At the present time I do not presume that 20 per cent of the services are metered. But there is no doubt that, if all the services were metered, which could be done at a cost of possibly $600,000, that about 5 per cent of the consumption could be saved, or about 5,000,000 gallons per day. That would tide us over for possibly two years by making that expenditure of money. Now, if we are in litigation with the Spring Valley Water Company, it would be very hard to expect that company would install those meters. If we own the system, we can install those meters, we can lay these distributing pipes, and we can proceed at once to take out what potentialities there are in this system. Mr. Freeman, in the report which he made for the City, recommended the construction of the Calaveras Dam, and all the estimates he made of water supply from that source average about 30,000,000 gallons per day of water. That dam would possibly take about three years to construct, it would take about two years to lay a large pipe line from that side of the Bay across to the City. But, by the expenditure incurred of $10,000,000, there is no question but that we could take 30,000,000 gallons a day more water out of that system than it is providing now. In case those negotiations should fail and nothing come out of this project of purchase, my office is preparing for the worst. I am making a well-study of all water-bearing strata in the City of San Francisco, so as to be able to get every drop of water available to tide us over a period of famine. But I sincerely hope, not only as a property owner, but as an official of this City on whom you have seen fit to place confidence, that this Board will endeavor to arrange the purchase of the system for the sake of our future and of a greater San Francisco.

SUPERVISOR GIANNINI: At the price that has been offered? That is the point.

MR. O'SHAUGHNESSY: Considering the offer of $35,000,000 two years ago and the $2,300,000 they have spent since then, that means $37,300,000 on the old basis, and if you deduct half of the impounded money from that, it would make it $36,600,000, plus the land around Lake Merced, 1500 acres, plus the Searsville land and the Market Street land. And, speaking about land and about valuations, Supervisor Koshland quoted from the report of J. G. White & Company $10,000 an acre as a value of those Lake Merced lands. I participated in the condemnation suits for the acquisition of the forty acres of land for the military post west of Lake Merced, some twelve years ago, and about a dozen real estate men testified under oath that the land was worth $2,500 to $3,000 an acre, while one real estate man, Mr. Thomas Magee, since dead, testified that the land was worth $800 an acre, and the jury in the United States Circuit Court awarded practically $1,000 an acre. And I simply recite this fact to sustain my opinion, that of placing a

very small amount of reliance upon the approximate estimates of these real estate speculative values. But there is one fact about it that has impressed me in connection with the Twin Peaks Tunnel more especially, that all this land that remains in the possession of the company will be subject to assessment under the Twin Peaks Tunnel project. That assessment we have not figured up exactly what it will come to, but I should think roughly from a million to a million and a quarter dollars.

SUPERVISOR GIANNINI: And the City is liable to be assessed on it, too, is it not?

MR. O'SHAUGHNESSY: The City, perhaps, under this tunnel law, will be exempt from assessment. But suppose the City is liable to assessment, and suppose this property remains in the hands of the City, when it would be liable for this enormous assessment, and where that money would come from is more than I can tell, and it might possibly defer and delay the completion of this tunnel. And I think that tunnel is a matter of very great importance to the future welfare of San Francisco. The people now are crossing the bay in ferry-boats instead of living on this peninsula, for want of transportation and home facilities.

SUPERVISOR A. J. GALLAGHER: What is the likelihood of the value of that land jumping materially by reason of the Southern Pacific coming up through that land that the possibilities of the Twin Peaks Tunnel being finished?

MR. O'SHAUGHNESSY: I never heard of any proposition of that kind. The motive of the Twin Peaks Tunnel is to develop the property at the southwestern end.

In reply to a statement of Rudolph Spreckels that the Spring Valley Crystal Springs lake was leaking 8 million gallons daily, on December 17, 1912, I addressed the following letter to the Mayor:

Honorable James Rolph, Jr.,
Mayor of San Francisco, San Francisco.

My Dear Sir: Your request of this morning for an explanation of the rumor that there was an abnormal leakage of 7 or 8 million gallons of water daily from the Crystal Springs lake of the Spring Valley Water Works has been duly received.

This rumor originated, no doubt, from a report made last summer by Mr. C. E. Grunsky (formerly City Engineer of the City of San Francisco) on water supply conditions affecting the same. The object of this report was to furnish matter for the United States Army Board in order to come to a conclusion as to the desirability of connecting the Hetch Hetchy reservoir to San Francisco. Mr. Freeman, to whom this report was first submitted, did not think it possessed enough value to be of any advantage to the City in the presentation of its case, as many of the assumptions contained therein were mere approximations, and not such as to warrant engineering conclusions such as those put forth by Mr. Grunsky. I have only made, personally, a superficial investigation of this proposition, but believe that any such conclusions that there is a seepage of 7 or 8 million gallons daily from this reservoir—are unwarranted. Furthermore, that there is no way to arrive at this subject but by extensive evaporation measurements from the surface of the lake, as well as accurate measurements of the water flowing in and the water flowing out of the same. I believe it is utter nonsense to assume that an earthquake could have provoked this leakage by any fault movement of the structural geology of the rock formation surrounding the lake. If any leakage at all took place, it would be through the structures made by man to impound

the waters. There is no evidence of leakage, however, at the dam which impounds the Crystal Springs lake. Having personally inspected the dams, I made close observations of leakage and seepage, and I think the hasty conclusions of Mr. Grunsky are purely imaginary and not based on proper findings.

The Spring Valley has been guilty of many sins in the past, and I have little sympathy with many of its operations, but I do not believe in the propagation of erroneous statements regarding its physical properties on which San Francisco has now to rely for a source of water supply.

Trusting this letter will give you all the information you desire on the subject, I remain

Yours very truly,

M. M. O'SHAUGHNESSY,
City Engineer.

During the year 1913 the Spring Valley Water Company started building a dam at Calaveras. Various matters of controversy occasionally occurred between the City and the Spring Valley Water Company over the operation of its system and the construction of its new works. The Calaveras Dam collapsed upstream on March 24, 1918, and I herewith quote a letter I wrote on this subject in October, 1913, to Mr. John R. Freeman, which explained my attitude toward the construction methods of the Spring Valley Water Company:

Mr. John R. Freeman,
815 Grosvenor Building, Providence, R. I.

San Francisco, October 14, 1913.

Dear Mr. Freeman:

CALAVERAS EARTH DAM

I have read with a great deal of interest your thoughts and views on the present Calaveras Dam project now being constructed by the Spring Valley Water Company under the jurisdiction of Mr. William Mulholland of Los Angeles.

For unknown reasons the company has prosecuted a policy of great secretiveness with regard to this project and only took me into their confidence about six weeks ago to the extent of inviting me Saturday afternoon to see the progress of their work, possibly with a view to inviting any suggestions or criticisms I might offer as to the propriety of their methods. I think Mr. Eastman, the Vice-President, is amenable to suggestion and desirous of doing things right, but I am afraid Mulholland and Hermann are so intensely conceited that they imagine all they might do should be immune from criticism. As the City has no official knowledge of the progress of this work, its officials can assume no responsibility for the outcome of that undertaking. The project is of such great importance, however, that its successful completion and operation is of vital interest to the survival of this community for the next seven or eight years, or until the Hetch Hetchy project is completed, that I took it upon myself to criticize severely the sloppy way in which this outlet work is being undertaken.

There is great hesitation on the part of our engineering profession to hurt the feelings of our brother members by adverse criticisms on their methods, but I did not refrain in this instance from almost overstepping the limits of politeness by emphasizing my objections to the reckless manner in which the construction of this outlet culvert was contemplated. It is usual in such construction to provide collars at least 2 feet thick, projecting every 20 feet from the exterior of the

culvert. This precaution against slipping and seeping was omitted from the intended plans, but restored at my suggestion to Mr. Eastman.

I also emphasized the importance of putting a hydraulic jet and digging out all the rotten rock along the foundation of the outlet, so there would be an absolutely uniform bearing and perfect contact with that structure.

The method of finding and washing the gravel and making provision for the voids was, in my judgment, slipshod and crude, as no proper provision had been made for segregating the different quantities of ingredients for the concrete, so that a uniform mix could be secured.

Another feature which made objectionable impressions on me was the flippant manner in which the young college boys in charge of the work and Mulholland, with his swollen ideas of accomplishment, have undertaken this very serious engineering project.

With ordinary care there are several points in its favor, as outlined. The first is that they have a very good bedrock support for this culvert, in which they have excavated for a foundation for the permanent outlet from the reservoir. I agree with you that a tunnel through the solid bedrock is a proper means of exit and I have suggested the practicability of plugging and filling this enormous drain culvert when the dam is finished, as such a large cavity through a structure in an earthquake country is a source of danger. Work on this project will necessarily be slow and undoubtedly they will see their way to adopt various precautions to insure its safety. One which I suggested was placing a large mass of rock on the downstream side of the dam to afford protection and facilitate drainage. This was sneered at by Mulholland as unnecessary, as he felt that all the coarser materials would stay on the outer slopes of the dam and furnish natural drainage, whereas the clay and sands floated to the center and settled, making a solid, uniform mass of impervious clay.

An earthen dam has been finished about a year in New Mexico, which was built under my directions and on which is provided a thick layer of rock on the downstream side, which helped to save it from destruction from one or two severe floods which passed over it while it was being constructed.

Both Mulholland and Lippincott have made a sad mess of much of their construction work on the Los Angeles Aqueduct and I warned Eastman that the reputation of the company would be damaged except that same high standard of construction were followed in the present work as the previous high standards followed by Mr. Schussler. The latter's nose, by the way, is out of joint and will have nothing to do with and will not even look at the proposed structure in Calaveras Valley, as his plans and advice were ignored in the project.

Considering the extent of values of life or property over $10,000,000 between this damsite and San Francisco Bay, it would seem to have been prudence to have put another million dollars into this structure and allay public fears as to any catastrophe which might follow from disaster following a failure. The action of the San Andres dam under earthquake conditions, which straddled a fault line, impresses me strongly with the merits of this type of dam in an earthquake country. If properly built, with all precautions against failure, including an impervious, watertight core, a downstream support of loose rock for drainage, ample spillway capacity, and most experienced and conscientious trained supervision in the construction, there is no reason why this type of dam should not be a great success.

Unofficially I am going to keep a watchful eye on this proposition so that the City will not inherit a "gold brick" if it should take this property over.

. . . . . .

Very sincerely yours,

M. M. O'SHAUGHNESSY,
City Engineer.

Since those days the City has expanded the use of the Alameda sources by an early building of the portion of the Hetch Hetchy Aqueduct between Irvington and Crystal Springs, practically 22 miles of pipe and tunnel. The general size of the pipe is 5 feet in diameter. It crosses the bay channel at Dumbarton by means of 3800 feet of wrought-iron pipe on an elevated bridge on the west side, capable of carrying two 7-foot pipes, and submerges under the channel by means of 3165 feet of 42-inch submarine pipe. This leads the water from Niles, across the bay, to a pumping station on the west side, from which the water is lifted into Crystal Springs Reservoir at elevation 290. By this means 34 million gallons per day of additional supply from the transbay regions was obtained to safeguard the supply for San Francisco.

Much credit is due to Mayor Rolph for his participation in the various campaigns to acquire the Spring Valley property, which have been controversial and vituperative, from 1915 to date.

The campaign of 1910 for purchasing all the properties for $35,000,000 was very nearly successful, except for the antagonism shown by a labor leader—ex-Mayor P. H. McCarthy.

Subsequent purchase campaigns were opposed by Rudolph Spreckels and Adolph Uhl, two obstructive citizens who showed aversion to all the City's policies. The final campaign in 1928 was led by Supervisor Franck R. Havenner of the Finance Committee, assisted by myself, Chief Assistant Engineer Eckart, and Mayor Rolph, and resulted in the final conclusive declaration of policy by the citizens, a victory of more than 4 to 1 vote, to acquire this large property for the sum of $41,000,000.

It took the citizens of London 100 years to acquire the private water companies, so it is a worthy record for the City of San Francisco to be able to do so after 30 years' combat in our diversified democracy.

During 1928 and the early part of 1929 the market for bonds retrograded, so that the City could not dispose of its $41,000,000 of bond issue and acquire the property until December 16, 1929, when a syndicate formed by A. P. Giannini, leader of the Bank of Italy, and the National City Bank of New York and others arranged to buy the bonds, so that by this means the City took possession of the Spring Valley property under municipal operation on the 2nd day of March, 1930, redeeming the $22,000,000 outstanding Spring Valley bonds, which will be retired November 1, 1930, under a financial arrangement satisfactory to the City and satisfactory to the Spring Valley Water Company.

AMPLE WATER SUPPLY FOR EMERGENCIES

San Francisco is living a hand-to-mouth existence in its water distribution. The reservoirs within the City, if kept completely filled, hold less than three days' supply for us. The inadequacy of this storage was forcibly shown in the 1906 earthquake. The four pipe lines leading to the City were broken by the quake shock, and due to leakage reservoir stocks were reduced to 7 million gallons. The inadequate amount in the City reservoirs became less and less, although feverish effort on the part of the water company's

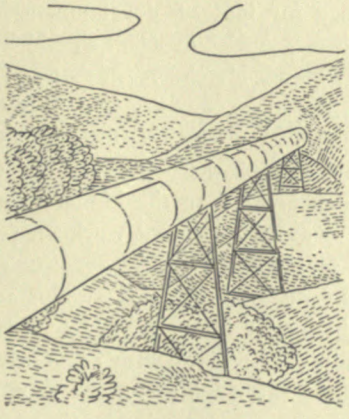
engineers brought immediately 7,000,000 gallons daily from Lake Merced, beginning sixteen hours after the earthquake, and 8,000,000 gallons from San Andres pipe line repaired at Baden, sixty-two hours after the earthquake. Four days after the earthquake the total amount of water in the City reservoirs had dwindled to the pitifully small amount of less than 7,000,000 gallons. Due to the temporary water shortage, thousands of persons left San Francisco, never to return.

The lesson is evident. Just as the nation entered the World War absolutely unprepared in 1917, so we encountered the disaster of 1906 without adequate preparation. An earthquake of the same intensity at the present time might cause equally dire results and it is plainly our duty to safeguard the situation and protect our people.

The remedy is simple. Let us build reservoirs within the City that will hold sufficient water for three weeks rather than three days. The City owns land on which can be built three reservoirs with combined capacity of over one billion gallons or twenty-one days' supply at the present rate of use. About $6,000,000 will be required for this work.

The reservoirs contemplated are Balboa Park on Ocean Avenue near Westwood Park, on land owned by the Water Department; Glen Park in the canyon which leads from Portola Drive down toward Mission Viaduct; and Amazon, near Geneva Avenue on the slope toward Visitacion Valley. Practically all of the land for the latter two has been purchased in individual parcels.

Safe policy dictates the construction of all of these reservoirs and one immediately when finances will permit.



CHAPTER VIII

Railroad Construction

IT WAS necessary to locate and construct a road to haul freight from the Sierra Railway running 23 miles easterly from Oakdale to Sonora and Jamestown. I had exhaustive studies made as to the most desirable route on which to survey and construct this railway, and after much thought assigned Mr. C. R. Rankin, who was an experienced locating engineer with the Southern Pacific Company, to undertake this work.

On the location of this road I differed in a substantial manner from the recommendations made by Mr. Freeman in his exhaustive report, and on January 27, 1914, wrote him on this subject:

This is the first time that I have made a thorough study of all features of the presentation of your findings before the Army Board. My previous efforts were confined to acquainting myself with those portions of your report which were pertinent to the solution of our controversy in Washington. I desire to compliment you on the exhaustive versatility with which you have covered all phases of the subject. There are a few points, however, especially with regard to preliminary work, on which I believe a more thorough study would have induced you to modify your conclusions. One is especially with regard to the development route paralleling the river from the Early Intake to the Hetch Hetchy damsite. I have made a very close personal reconnaissance of this last summer and find that such a route on the south side of the Tuolumne River would be extremely expensive as the slopes are very nearly perpendicular and much tunneling would have to be done to complete the route which you recommend. A route at the base of the bluffs would be subject to land slides and rock slides, as well as snow slides during the five winter months of the year, which would render it almost impracticable and very expensive for use.

As our scheme is now outlined my idea of development is that the *section* from the Early Intake to Moccasin Creek and the *Hetch Hetchy Dam* should be completed at the same time, and that portion of the aqueduct from Hetch Hetchy Dam to Early Intake deferred to a remote date until more power is economically needed by the City. From my experience in mountain countries, and I have already developed four large water projects and completed them on time, in country as rough as that of Hetch Hetchy, I think the best route for a road is from the Hog Ranch or a little to the west of it into Hetch Hetchy on the higher levels, by grades not exceeding 4 per cent, and adjusting the location to avoid expensive work on precipices and tunneling. I built a railway in Shasta County twenty years ago on a 3.75 per cent grade with 180-foot radius curves, which handled about 2000 tons of material per day without accident or difficulty. The amount of cement and other material to be hauled into Hetch Hetchy is relatively small and a Shay locomotive on such grades could handle our freight with economy. From the Hog Ranch west, the road could be located on the crest of the ridge along the most available route, and hugging very closely to the shaft locations of the proposed work. For a permanent road to the Hetch Hetchy this location will be more desirable than the one down in the canyon (recommended by you), as it will be more cheaply maintained, and under the terms of the Raker Act it is up to the City to maintain the roads.

In the construction of the Stanislaus work by Sanderson & Porter, of New York, a great many mistakes were made in their mountain development through their lack of familiarity with our con-

ditions. One of the wisest schemes, however, adopted by them was to build their transportation line on the summit of the ridge, where, by inclines, all the material for the work below was very economically handled.

I am writing you fully on this problem because I have the sincerest respect for your opinions and do not desire to make any recommendations which are in conflict with your conclusions, without fully acquainting you with the reasons therefor.

To this Mr. Freeman replied on February 3, 1914:

Relative to road locations, I recognized that parts of this road would be expensive, but after studying the canyon side from many viewpoints and examining the actual character of construction encountered in Ham Hall's road building, it seemed to me that, taking the long view, it would probably be worth while to locate the road substantially as indicated in my report and maps, although if it were merely a question of getting cement and other supplies to the Hetch Hetchy damsite in the cheapest way, I do not doubt that a cheaper route could be built by the way of Hog Ranch.

As features controlling my design, I kept in mind a feature with which apparently I am more strongly impressed than most of my friends, namely, the desirability of having this road one of the attractions and assets of the San Francisco and Central California as an easy grade highway into the heart of the high Sierras. One of the greatest advertisements for a city is a magnificent water supply and I believe it has a distinct value which the community can afford to pay for by bringing the water supply and its various virtues into the public view as frequently and conspicuously as possible.

Perhaps one reason why I have been more impressed with this feature than most of my friends is because of my various travels in Europe, over roads built by the government for the recreation of the people and to encourage good spenders to visit their country. Moreover, I have been particularly impressed in my automobile trips around the magnificent roads built by the City of Manchester encircling Lake Thirlmere, over which ten thousand people travel each year, including thousands of bicycle parties; and also my visits to the Vyrnwy Water Works of Liverpool in North Wales, and the newer works of the City of Birmingham in Central Wales, where in each case the city has sought to add to the beauties and easy access to the region by building good highways, which encourage bicycling and automobiling.

In considering grades, I had the English, German and Swiss cyclists in mind.

Another important feature was easy access to tunnel adits, for it seemed to me that the natural way to build the tunnel from Early Intake to the Hetch Hetchy was by a series of relatively short runs between the gulches, permitting the grout to be cheaply dumped from the adit without hoisting, and also permitting the cement lining and collapsible metal forms, etc., to be run in from the highway by electric locomotives. I believe this section from Early Intake to Hetch Hetchy will come to pass probably much quicker than the curve of population increase alone would call for, because of the water power that can be gained.

Also I was desirous of leading the road into the Hetch Hetchy Valley in a way that would make it useful for building the Poopenaut Dam, which I also believe will come quicker than the curve of population increase would imply, particularly now that the irrigationists have been given rights to the natural flow up to 4000 second feet (for 60 days each year). My studies of mass curves of the river flow in low years show that this extra grant to the irrigationists ought never to have been made, and will be a terrible burden on the ultimate development. After studying the landscape, it seemed to me that we could make this road most interesting by leading it along not

too far above the high water level of the Poopenaut Reservoir, up to the point where, as one rounded the corner, he would get the most impressive view of the future high Hetch Hetchy Dam.

I hope, also, that when the time comes, an enlightened public opinion will grant the right to build a power house at the base of the Hetch Hetchy Dam for developing the potentialities of the Eleanor and Cherry water. Possibly the low level road would work out a little more conveniently than a high level road as a means of communication between this power house and the one at Early Intake, and permit the smallest possible operating crew, relying for emergencies upon quick access from the power house a few miles downstream.

It seems to me the scenic value of the whole proposition will be made most impressive if one is led up to the lake so that the height of the cliffs and their relation to the lake will burst on him as he rounds a corner or climbs over a summit at our so-called hotel site near the dam, rather than to first get the distant view as at present from a high and distant point.

I will frankly admit that Mr. Hammatt and Mr. Ropes, from their strict utilitarian viewpoint, were disposed to adopt a somewhat different route for the road from that which I finally indicated in my report, but while I recognize there was about three-quarters of a mile of cliff bench work, I thought a touch of this would add interest to the tour, just as I have found it in my Norwegian travels.

I recognize, of course, that the whole matter would have to be worked out by location studies on the ground, but wanted at least to force attention to the considerations that I have named when striking the balance between the cheapest possible road into the Hetch Hetchy and the one that would for all future time serve the people best.

I have seen a good deal of the work of the Shay locomotives in the mountain country and in logging operations and have no question of their feasibility both for steep grades and for sharp curves, and I would not hesitate to make the canyon side road with extremely sharp curvature.

Between Smith Station and the Early Intake, different conditions prevail and for this region the tunnel will have to be built chiefly from shafts, therefore the road may properly cut across country with consideration only to access to shafts and the obtaining of the best possible grade for the future highway.

Very truly yours,

(Signed) JOHN R. FREEMAN.

The Poopenaut Dam would only hold about 30,000 acre feet of water and back the floods up against the dam at Hetch Hetchy. In the light of finer damsites at the higher levels above Hetch Hetchy, where storage of water may be more cheaply made, the Poopenaut will never, in my judgment, be constructed, although from an anticipated or artificial view, as suggested by Mr. Freeman, it presented possibilities. The scenic views obtained from the new location on the crest of the hill are far more desirable than those obtained from the contemplated road sunk down into the bed of the canyon. The present road is all accessible to the roads leading to the Yosemite, as the finest vistas are obtainable from the route selected by me.

There is no point whatever in Mr. Freeman's objection to the 4000 second foot clause in the Raker Bill. This document was framed without Mr. Freeman's assistance in the early part of 1913, by the attorneys and engineers of San Francisco, and had to be written in this way to meet the claims of the irrigationists. Under the original Eleanor Grant, the Garfield Permit, the irrigationists were given the rights to make dams above

Lake Eleanor and Hetch Hetchy, and the City's $45,000,000 bond issue was voted with this condition in force.

In reply to Mr. Freeman on March 5, 1914, I wrote him:

If you will look at page 8 of the Army Engineers' Report and paragraph 5 of the Garfield Permit, you will notice that the irrigationists had the right to invade the watersheds of Hetch Hetchy and Eleanor and impound waters at the higher levels, and intercept the storage waters tributary to those reservoir sites, occupy, possess, and otherwise interfere with other sites located above the City's sources. The waiving of this right by the irrigationists could not be procured without a counter concession on the part of the City, which was made by Mr. Long and myself in Washington, after very due and mature consideration, and from this study of the possibilities of the watersheds and practicability of making cheap rock-filled dams at the higher levels, I believed the exchange was a very desirable one for San Francisco and of great future benefit to the City, as there cannot be in the future any interlocking of interests in construction work between the irrigationists and ourselves. At this period I believe you were in Europe and not available for consultation as to the merits of the arrangement. I am prepared to accept full responsibility for it, and the Supervisors, the governing authorities of this City, sustain my judgment in its handling, so that it should not be a subject for discussion now were it not alluded to in the last two brief references in your late letters.

Very truly yours,

(Signed) M. M. O'Shaughnessy,
City Engineer.

The difference between 4000 second feet and 2350 second feet for 60 days would amount to 198,000 acre feet, which the City has to release in the flood season of the year, and by building dams of fairly moderate height over one million acre feet can be accumulated by storage in the higher levels of the City's watershed. So there is no reason whatever to worry or quarrel about the release of water for the 60-day period which Mr. Freeman worried so much about.

In a letter to Mr. Freeman of August 24, 1914, I wrote:

You will be pleased to note that we have the Pleasanton Well situation very well in hand. Careful measurements were made during the last year, which sustained fully your conclusions on the output, and I will take pleasure in a short while in sending you a copy of our findings.

I am rather surprised that Manson should be still in the ring with his fears. It was due to his negotiations that the Garfield Permit was formulated which gave the irrigationists the right to build dams and conserve the water above our three reservoir sites inside the National Park, and if it were not for his imprudent bargaining the labor of the present City officials would be considerably eased. When the battle was on he sought careful refuge in the cyclone cellar and now he emerges and seeks to impeach the work of the men who successfully made the fight on the City's behalf.

In a letter of September 1, 1914, discussing the power possibilities, he wrote:

I appreciate that, under the conditions of today, the power development is of paramount importance, but I think I have told you that why I put the soft pedal upon it two years ago was largely

from memories of the intense bitterness and fierceness of the fight which the power companies serving Los Angeles made against a full-size aqueduct.

On January 8, 1915, I wrote Mr. Freeman:

HETCH HETCHY PROJECT: On the 8th of July we opened bids and awarded contract for the first 9¼ miles of road into the bench 300 feet above the damsite. Due to the tardiness of the contractors they did not get started until six weeks later and they are now paying the penalty for delay by working in the snow under disadvantageous conditions, which will possibly cause them a loss on their contract of between $40,000 and $50,000. I strongly urged them on the advisability of push and speed in tackling this work, but they ignored my suggestions and are now paying the penalty.

During the past year, due to the war, there has been no sale for 4½ per cent bonds, so we had to proceed slowly with the means at our disposal. I have, however, got the railway line located nearly as far as Groveland by one of the best locating engineers in the West, who was selected as one of the engineers for the government railway by the Alaska Commission, but elected to stay in my service at a lesser compensation.

I am sending down a report this week to our Board of Supervisors for money enough to complete the railway and the other preliminary work. I believe the bond market is now improving and I have hopes we shall be able to sell a block of bonds this spring which will enable us to prosecute this work.

From our previous Washington experience, I am going to press the cleaning of the damsite and reservoir site of trees, and the construction of an outlet tunnel to draw off the waters while putting in the dam foundation, lumber cutting for camps, and other necessary preparatory work this coming year. I have also been making studies on the ground and on paper of the plans for the proposed dam and hope to be able to ask you to pass judgment when the final type is selected, its foundation and the method of construction, inside the next few months. I am also starting tunnel work at the Early Intake aqueduct so as to make a stronger physical demonstration of our intent for diversion of water to protect us in our controversy with the irrigationists. The Modesto directors have had a row in their camp and discharged their engineer, so they are not now in shape to go to court with us, and as time is working in our favor we are awaiting the proposed legal contest with interest but no anxiety.

In the December, 1914, proceedings of the American Society you perhaps have noticed a discussion by Mr. Grunsky of the Hetch Hetchy project. His attitude in this matter again reminds me of the trite saying, "Whom the gods would destroy they first make mad." I think his discussion is essentially stupid, misleading and rather disreputable for anybody claiming a decent standing in the engineering profession. While sneering at the eastern engineer he makes no allusion to his own blunder of discovering an unknown leakage of 7 million gallons a day in the Spring Valley Crystal Springs reservoir, which does not exist, and this finding is rather a poor product of engineering talent the City has spent a large amount of money in educating. I have previously discussed Mr. Corey's paper in a rather complete manner and I presume it will be in print next month, and I do not know whether, under the rules of the Society, I am permitted to make a second discussion of Mr. Grunsky's paper. If I do not do it, however, somebody else will and if you can spare the time to pass a few remarks on the subject I think your comments will be of much interest to the engineering profession.

It is the intention to put the Spring Valley purchase up to the public for approval in March or April and I have doubts as to the success of the proposal. There is a very serious prejudice against the Spring Valley in this City and a continuous campaign of misstatements for over 12 years has

been made with regard to the property and its product, and as the great masses of the City would rather pay an extra price for water from their own sources and have the privilege of punching the present company, personally I have very serious doubts as to the success of the election. If this property is not purchased a tremendous economic waste will be had by duplicating the distributing system, paralleling of reservoirs, pipe lines and other structures throughout the City and the division of the earnings from competition between the City and the private corporation. The Spring Valley has now over 72,000 consumers and 80,000 taps and are taking in about $3,400,000 a year. Four and one-half per cent of $34,500,000 would amount roughly to $1,600,000, so that if we acquire the company we will get enough revenue at the present rates for the interest on the purchase price, operating expenses, and also pay money into a sinking fund. I am doing all I can personally to aid in the acquisition of the company's properties by the City, but I am afraid politics is going to run into the question.

If you have any concise data on water rates in eastern cities of recent date, showing the price of water per thousand gallons, I would like to have a copy of it. I believe the retail price in New York is about 16 cents per thousand gallons.

Letter received from Mr. Freeman dated February 3, 1915:

Yours of January 28th acknowledging Lochridge's tables is at hand. On Sunday I found my first opportunity to look into the transactions of the American Society of Civil Engineers and read your reply to Mr. Corey with the greatest of interest. Not for years have I read anything in the Society Transactions that I enjoyed so thoroughly as I did your apt and vigorous English and the straightforwardness with which you have opened up the truth.

I heartily concur with you in your views relative to using the Society Transactions for the kind of material that Corey and Grunsky have put in, but times are hard now for engineers and there is a tradition that "advertising pays".

But I cannot see just where you and I and all the rest of the membership are forced to pay for this advertising and have our copies of the Transactions encumbered by matter that has no professional value.

DESCRIPTION OF RAILWAY

For the purpose of transporting construction equipment and materials for the Hetch Hetchy Dam, the aqueduct tunnels and the power plant, a standard gauge railway was built on grades not exceeding 4 per cent and on curves not less than 190-foot radius, extending along the entire work, including the foothill and mountain divisions. The Hetch Hetchy Railroad, 68 miles in length, connects with the Sierra Railway at Hetch Hetchy Junction, 26 miles from the town of Oakdale, and extends to O'Shaughnessy Dam.

Starting at Hetch Hetchy Junction, at an elevation of 935 feet, the route leads across rolling country and descends into the Tuolumne River Canyon to 600 feet elevation. It then follows up the river, crossing it on a steel bridge below Jacksonville. At Moccasin Creek a steep climb begins, and continues until summit elevation 3070 is attained at mile 26, about 1½ miles west of and near the headquarters town of Groveland. From this point east the line follows generally the dividing ridge between the Tuolumne and Merced Rivers. Thence the general elevation increases until at mile 62 the highest sum-

mit is reached—Poopenaut Pass—at elevation 5064. Six miles of continuous descent on a 4 per cent grade complete the 68 miles to Damsite, where the elevation is 3870 feet. The last nine miles of the railroad was built on the roadbed previously graded and used as roadway.

The railroad serves the working points of the 30 miles of main aqueduct east of the Sierra Railway, the Moccasin Power development, and the City's sawmill, some directly, others through short spur tracks, tramways, or motor truck hauls. Haulage from the railroad is generally in the downhill direction.

The railroad was commenced in 1916—with over 1,000,000 cubic yards excavation, and completed in October, 1917. It was operated from July, 1918, to February, 1925, as a common carrier. Freight rates were on a basis of 12½ cents per ton mile for carload lots for all freight except lumber and livestock, on which commodity rates were established. The basis of passenger fares was 7½ cents per mile.

The City purchased the necessary equipment, consisting of six locomotives, to operate this road. The principal freight was cement from the cement companies, which was shipped in bulk in box cars to the Hetch Hetchy terminal. Some days as much as two thousand cubic yards of concrete was poured in the dam, which meant the use of over two thousand barrels of cement, or 400 tons. The heaviest load any of our locomotives could haul up the steep grades was three freight cars, each with a capacity of 250 barrels, and in order to safeguard the stocks on hand we had on two occasions to rent additional locomotives from outside railway companies to tide us over the peak load temporarily. Various means of carrying cement were considered—truck haulage and other alternatives, but it was clearly demonstrated that the railway was an economically sound and wise part of the construction program.

The cost of construction of the railroad was about $3,000,000. The early use of the road enabled the City to complete the O'Shaughnessy Dam in April, 1923, in three and one-half years, and thereby gave San Francisco priority in the storage of the flood waters of the Tuolumne River.

The subsequent completion in 1924 of the Don Pedro Reservoir by the Turlock and Modesto Irrigation Districts necessitated the relocation of that part of the Hetch Hetchy Railroad at the Six Bit Gulch Crossing, the old trestle at this point being four feet below the flow line of the reservoir. The trestle was replaced by a nine-span plate girder bridge, 585 feet long, 15 feet higher in elevation than the old trestle. The reconstruction of this bridge and the relocation of adjacent stretches of track were made on request of, and were paid for, by the two irrigation districts—Turlock and Modesto.

CHAPTER IX

Work Progress

ANOTHER unit of the work was undertaken in the construction of the dam across Hetch Hetchy Valley. Mr. Freeman made various preliminary sketches for this dam and incorporated them in his book, which gave us a guide to follow. A transportation road was necessary for the construction of any dam and its history is written in the previous chapters.

Early Intake. The water was allowed to flow from the dam at Hetch Hetchy down the Tuolumne River streambed twelve miles to Early Intake. There was a diverting dam constructed at this point which leads the water into the 19-mile aqueduct to Priest Tunnel above the Moccasin Power House.

Considerable modification had to be made in Mr. Freeman's route for the aqueduct. At South Fork crossing a 3000-foot exposed, inverted steel siphon pipe descended into the bottom of the canyon. I changed this location by making it an all gravity aqueduct route on natural grade and shoving the direction of the aqueduct a mile south to South Fork, and kept the route a gravity one all the way through the mountain from the intake down to its terminal.

Moccasin Power House. I also designed the power house at Moccasin Creek, which initially consists of four units, with a vertical drop of about 1300 feet, which develops about 100,000 horsepower. With further hydraulic developments the power house is capable of being expanded 50 per cent by taking out the southerly wall and extending the building with the completion of construction of other project units in the mountains, to store more water. This portion of the project, including the dam, the aqueduct and the power house, was completed and placed in operation in 1926, bringing in an annual net revenue to the City of over $2,000,000, since the 22nd of August, 1925. Various controversies and political cat-fights had developed during the construction period—something not unusual in municipal enterprises—but the final result was eminently satisfactory to the people and the taxpayers of San Francisco, and they are the proprietors for whom I have been working and who have to pay the bill.

The first actual physical camp on the work was known as the Greek Camp, constructed in 1914 about one mile easterly from Hamilton Station. A barn, corral and a warehouse 20 by 60 were constructed at this point.

The Hog Ranch wagon road, 3.71 miles long, was graded from Red Hill easterly in the spring of 1914, and was the first actual construction work done under my supervision of this project.

Transportation Road. The first nine-mile unit of the railroad construction was awarded on contract July 8, 1914, to the Utah Construction Company and was completed the following January.

Stream Measurements. Hydrographic work on the river branches has been continued under an agreement with the United States Geological Survey. The officials at Washington were extremely eager to extend their sphere of influence and wanted to impose two hydrographers on us to make those measurements, which under the Raker Act had to be done under government supervision. I protested against the employment of excess men and seeing that three hydrographers covered the whole State of California, I thought one man should adequately cover our water supply. After protest to Secretary of the Interior Lane I got his approval of my program for a reduced number of government employees on the City's payroll.

Various maps and plans had to be made for filing at the Sacramento Land Office in compliance with the Act of Congress, and we had a Washington attorney, Mr. R. Woodland Gates, who was in constant contact with myself and the City Attorney's office and aiding us in filing all those maps and records in the Interior Department which formed a buttress on which to rest the future construction activities of the City.

In 1913 I had a report made on the water sources from all wells inside the boundary of San Francisco, in which over 700 wells were spotted and measured, and a review in the shape of a published book issued on same. This has enabled us in later years, after test borings in the Richmond and Sunset districts, to determine the character of the underlying strata, and it has fortified the City in going ahead with its pumping station and well zone at Forty-fourth Avenue, south of Golden Gate Park, which gives us an opportunity to develop about 6 million gallons daily.

Permanent Camp. The construction of camp buildings at the Hetch Hetchy damsite was begun in September, 1915, the first building constructed being the dining room, 120 feet by 40 feet. This was followed by the construction of bunk houses and cement warehouse, which was so located that the cement cars could be brought on the railroad track right alongside the floor of the warehouse.

Diversion Tunnel. For the purpose of by-passing the stream flow of the Tuolumne River past the excavations in the riverbed for the construction of the dam foundations at Hetch Hetchy, a tunnel was commenced September 17, 1915, on the south side of the river. Two crews were put to work with hand drills and the heading was drifted through the 30th day of September, 1915. The tunnel was originally twenty feet in diameter and when the contract was awarded for the construction of the dam in 1919, the section was enlarged on my orders by the Utah Construction Company to 25 feet by 23 feet.

Preparations were made to construct the diversion dam. A bench was excavated in the solid granite 100 feet above the dam, where a hoisting engine, derricks, carts and wire rope cable could be installed. Due to official Washington, the Assistant Secretary of the Interior delayed this construction from April till August, 1915, before giving us his approval. It is needless to state that delays of this nature by Washington officialdom have proved a serious handicap to the progress of the utility in seasonal work in the high Sierra, where the fair weather open season is so short due to heavy winter snows and frosts.

Canyon Ranch Sawmill. The City owned timber land at Canyon Ranch along the railway grade, about five miles west of Hetch Hetchy, and work on the sawmill there was started in April, 1915. The sawmill machinery was purchased and hauled by truck from Chinese Station to Canyon Ranch during June, and installed in July. Actual cutting of lumber commenced July 21, 1915. During the fall a large part of the 1,200,000 feet of lumber manufactured was hauled to the damsite for permanent camps, in the remaining part of the season.

Lower Cherry Power Development. In order to supply power for construction purposes for the project, active work progressed on a temporary power plant at Early Intake. An aqueduct 17,000 feet in length, 5200 feet of flume, and 7200 feet of open ditch were constructed from Cherry Creek southeasterly to the forebay, about 345 feet above the power house at Early Intake, which generated 4500 horsepower.

CONSTRUCTION ACTIVITIES IN 1916

Contract was awarded for $1,543,080.74 to grade and construct a 59-mile roadbed from Hog Ranch westerly to Hetch Hetchy Junction, about 23 miles east of Oakdale on the Sierra Railway. Alternative bids were invited for specifications for classified materials, such as granite, solid rock, soft rock, and earth, and the City found that non-classified specifications at 67 cents per cubic yard were more desirable, and contract was awarded on this basis.

Officialdom in the person of the State Engineer at Sacramento again attempted to compel the City to build and maintain overhead crossings at all points of intersection with the Big Oak Flat Road, but through the protest of the City Engineer and City Attorney, the State Railroad Commission was prevailed upon to remove the jurisdiction of the State Engineer from any further interference with the City's plans.

The Southern Pacific practically donated its services to build and operate the railway along Owens Valley for the convenience of the City of Los Angeles, but no corporation could be prevailed upon to undertake this service for San Francisco.

In order to make the railway self-supporting, paying all cost of operation and maintenance, interest on cost of construction and equipment, it was necessary to charge for transportation the following rates: passengers, 7½ cents per mile; freight, 15 cents per ton mile, which made transportation per ton of freight from Hetch Hetchy Junction to the damsite $10.15 and passenger fares $5.00.

CHAPTER X

Activities Subsequent to 1917 and 1918

CHERRY RIVER AQUEDUCT. This involved preparatory work for the construction of a 200 second foot aqueduct from Cherry River to Early Intake on Tuolumne River 3.3 miles long, consisting of 1.2 miles of tunnels, 1.1 miles of flume, and 1 mile of concrete lined canal, which followed around the slope of the mountain to immediately above the Early Intake power house.

Most of the excavation of the ditch was done by day work with labor at the Charter rate of $3 per diem, and the tunnels were let on contract to McArthur Brothers for $17 a foot.

The power house, a temporary frame building 30 feet by 80 feet in size, contains three turbines under a maximum head of 345 feet, fed by a 42-inch pipe line 530 feet long, each direct connected to a 2300 volt, 1000 k. v. a. generator. This power is transmitted at 22,000 volts 11 miles east to Hetch Hetchy Valley and 22 miles west to Moccasin Creek, supplying the intermediate substations, including the two shafts along the line. This system has furnished all the power needed for all the Hetch Hetchy water supply construction activities, including tunnels and dam construction, and surplus power has been sold to the Sierra and San Francisco Power Company through a connection at Priest at one-half cent per kilowatt hour under a contract entered into during the war period, according to the following letter received by me from H. G. Butler, Power Administrator:

Washington, D. C., September 18, 1918.

Dear Sir: I am advised that you have available considerable electric energy from a power plant constructed for the Hetch Hetchy project. The Sierra and San Francisco Power Company informs me that it has a line which can transmit all the power from this point.

In view of the present power shortage and the imperative need of making use of all the power available in order to protect shipbuilding and other essential war industries you should at once make arrangements to turn this power over to the Sierra and San Francisco Power Company so that it will be available for general use.

This letter should be construed as a formal order to that effect.

Yours truly,

(Signed) H. G. BUTLER,
Power Administrator.

The following was the offer from the Sierra and San Francisco Power Company:

Referring to your letter of July 9th, I understand that all arrangements have now been completed for delivering power on our lines at Groveland from the Early Intake hydro-electric plant. We agree to pay the City monthly at the rate of one-half cent per kilowatt hour for the net input

of electric energy into our system at a point where the meters have been installed, viz., "at Priest Reservoir Camp Site".

It is our understanding that some 45 feet of line have been built by you from the said point where the meters have been installed to connect with the Pacific Gas & Electric Company's lines near Priest Station over which the delivery will be made. We would request that you begin delivery of energy at this point as soon as practicable, in accordance with the terms of your letter of July 9th referred to above.

Yours very truly,

(Signed) H. F. JACKSON,
President.

L. W. Stocker, H. J. Schaufele, and E. F. Muheim were the original engineers engaged on the location and excavation of the Cherry Valley aqueduct and tunnels, superseded in the fall of 1917 by L. T. McAfee, who had just completed the Twin Peaks tunnel and who also supervised the concrete canal lining and subsequently became the resident engineer on the 19-mile main Hetch Hetchy tunnel aqueduct from Early Intake to Priest. Mr. Paul J. Ost was electrical engineer.

Eleanor Dam. To insure sufficient water for continuous operation of the power house it was rendered imperative to raise the level of Lake Eleanor 30 feet and therefore a dam was designed which was to be constructed at Lake Eleanor about a mile below the lake, on solid bedrock, to accomplish this purpose.

The first thought was to agree with Mr. Freeman's recommendation to make a low earth dam on the gravel strata near the lake outlet, but test pits made along the formation showed a glacial deposit of deep beds of porous gravel 3000 feet wide, which would make the foundation problem for dam construction at this point particularly hazardous and expensive. So it was finally and conclusively decided to build a slender concrete dam one mile downstream from the lake on solid bedrock, consisting of 20 buttressed arches, each with spans of 40 feet, with gravity concrete approaches at both ends. The total length is 1260 feet with a maximum water head of 70 feet. It contains 11,640 cubic yards of concrete, heavily reinforced. The late Mr. Frank Boothe was resident engineer on this dam construction and rendered excellent service.

Several original features in design were developed by the City Engineer's assistants engaged on the study of this dam, among those engaged being the late R. P. McIntosh, main designing engineer, and the late R. J. Wood, also Mr. L. H. Nishkian. Mr. Lars Jorgensen was retained as consulting engineer.

The arches are on an incline of 50 degrees to the horizontal buttresses. The center of the dam has an upstream angle of 30 degrees which involved special design for the central eight tapered arches. An interesting and novel feature for the engineer is that the cross-section of the arches follows a circular arc of uniform thickness on a horizontal plane and an elliptical arc on a normal plane, which is an innovation in this type of structure and the reverse of the practice heretofore followed in the design of this type of dam. Over the entire crest length is a reinforced concrete roadway twelve feet wide.

The dam was commenced in August, 1917, put in service in June, 1918, and completed in 1918. The entire cost of the structure, including a 12-foot wagon road to Hetch Hetchy about 28,000 feet in length, was about $320,000, which is a phenomenal record with City's day-forces in wartime.

The flow line of the reservoir created at the dam is at elevation 4660 feet, with a capacity of about 27,800 acre feet, or nine billion gallons. This quantity is only a small part of the storage possibilities that may be ultimately developed at this site by building a large rock fill dam, with crest elevation of 4810 feet and contents of 218,000 acre feet, or 71 billion gallons. The present concrete dam may be used for an upstream toe for the water skin of the larger dam.

The construction of this large Eleanor Dam is considered an integral part of the Hetch Hetchy system, to be undertaken and completed, first, when the additional water is a necessity, and secondly, when the value of power becomes commercially justifiable. The additional supply for this large reservoir will be obtained by building a large flood diverting canal from Cherry River at a high level southeasterly across country, discharging into the sag in the mountain about a quarter of a mile east of the present Eleanor Dam. The aqueduct on this route has been all surveyed and the approved plans filed with the Interior Department in Washington.

During this construction period heavy drafts for the service to the United States Army and Navy war activities were made on the City's skilled engineering and clerical forces, thirty-five men having joined the service, most of whom obtained rank as officers in the Army and Navy. It was not until a period of one year had expired after the conclusion of the war that my assistants rejoined the City's service and all obtained their pre-war position.

Health Service. On July 10, 1917, Ordinance No. 4248 of the Board of Supervisors authorized the Board of Public Works to make arrangements to provide for the health and safety of all persons employed on the Hetch Hetchy project. The City's employees were required to contribute one dollar a month out of wages towards maintaining a doctor and hospital. Dr. E. T. Gould, of Sonora, Tuolumne County, was the first doctor in charge of the City's hospital at Groveland. The men were also insured in the State Compensation Insurance Fund, which charged various premiums for different kinds of activities, at rates varying from 18 per cent for blasting to 1 per cent for janitors.

Accounting. A special accountant was appointed by the City to act in cooperation with the bookkeeper of the Board of Public Works. Main accounts were divided into two classes, namely, main accounts and sub-accounts. The main accounts were designated by number and referred to the main division of the Hetch Hetchy work. The sub-accounts were designated by the letters of the alphabet. In order to validate the procedure under which material and equipment for the Hetch Hetchy project were to be purchased, the City Engineer recommended that one of the dealers supplying material to the Hetch Hetchy project bring a mandamus suit—a test case—against the Auditor

to pay his demand on the City Treasurer therefor. The suit was brought by Edward L. Soule, who supplied corrugated reinforcing steel for use in the Eleanor Dam. The following is an excerpt from the decision of his Honor Judge Nourse, to whose court this case was assigned:

> Inasmuch as none of the provisions of the Charter requiring solicitation and preparation of bids to be used by the Board of Public Works in connection with the construction of a public utility, such as the Hetch Hetchy Water Project, it is necessary for the defendant to show that such competitive bids were required by reason of the provision of some ordinance of the Board of Supervisors. If, therefore, any such ordinance exists it is necessary for the defendant to plead it, because the Court is not authorized to take judicial notice of ordinances of the City and County. Since it could be, by reason of such an ordinance, only the competitive bids would be required before the contracts here involved could be entered into, in the absence of such a showing, it must be deemed that they were properly executed and a peremptory writ should accordingly issue to require the defendant to prove all the demands of the plaintiff set forth in his complaint, which have not heretofore been audited or approved by him.

When the new City Charter was adopted in 1900, no provision was made therein for the mechanics of construction of such large public utilities outside the limits of the City of the magnitude of the Hetch Hetchy project.

Due to the rate of interest on the bonds being 4½ per cent and the bond market being shot to pieces during the war period, it was impossible for the City to sell its water bonds at par, so at my suggestion the voters of San Francisco amended Article XII, Section 10b, of the Charter as follows:

> The Board of Supervisors is hereby authorized to sell bonds of the issue of July 1, 1910, described as Water Bonds Issue of July 1, 1910, below the par value thereof, such price, however, not to be less than that will net the purchaser 5½ per cent per annum, according to the standard table of bond values.

The election on the above amendment was held November 2, 1920, the proposal validated, and the amendment approved by the Legislature January 21, 1921.

Very fortunately the people of San Francisco adopted this Charter amendment, which enabled the work to be continuously prosecuted in an orderly manner during very strenuous financial times.

The United States, in building the Panama Canal, completed in 1915, was able to issue and sell bonds at as low a rate of interest as 2 per cent. The federal bond issues during the war period were elevated to 5 and 5½ per cent. How then could a city sell bonds at 4½ per cent in competition with federal issues? It was absolutely impossible.

O'Shaughnessy Dam and Reservoir—Foundation Conditions. The Hetch Hetchy Valley forms a glacial basin with gravel detritus from the high Sierra. Its lower outlet, through which the Tuolumne River flowed, is 60 feet wide at ordinary water level 3500 feet. It is 900 feet wide at the crest elevation of the dam, elevation 3812.

All previous engineering studies by Mr. Freeman and others estimated the depth of bedrock to be from 28 to 30 feet. However, before sinking the cofferdam 100 feet upstream from the main dam for the diversion structure, trial wash borings were made by Mr. McIntosh which showed a depth of 100 feet without reaching bedrock. This alarming condition caused the City Engineer to make a contract with the International Diamond Drill Contracting Company, awarded January 5, 1917, for 1900 feet of test borings. In all 20 holes were sunk, from which it was determined that the average depth to bedrock was 72 feet. This situation brought us back to the proposal of relinquishing the then arch concrete proposed dam and of making a temporary diverting dam of the rock fill type and incorporating it with the contract for the main dam.

The crib dam in the plan had an upstream angle and formed an easy entrance to the tunnel. This dam was composed of 12″ by 12″ timber, pinned together with one-inch bolts. The lowest timber elevation was 3504, the crest being 3540 feet, top width eight feet, with upstream batter of three inches per foot and downstream steps of four feet with six-foot rise. Timber spacing was eight-foot centers, the pockets being filled with large loose rock dumped from cars and partially hand placed.

The upstream face was sheathed with a double layer of two-inch plank, between which was a layer of burlap. The crest of sheathing was carried to elevation 3540 feet at top of the crib dam. A row of eight-foot sheet piling, 16-foot lengths, was driven across the streambed to a layer of horizontal hardpan about one foot thick overlying finer materials, sheet piling crest 3507½ feet, the space between the sheathing and sheet piling being filled with an asphalt mixture. The length of the crib dam was 321 feet. In the summer the dam successfully resisted the maximum flood water of the year—about 8000 second feet—which reached an elevation of 3538 feet. I induced the contractors to raise the crest of this dam five feet, which saved the excavated foundations from being filled with debris during peak floods.

The easterly boundary of the watershed extends to the Sierra Nevada summit, a distance of 40 miles. This creates an excellent watershed, as most of the formation is in solid granite, devoid of soil or vegetation.

The bottom of the Hetch Hetchy Valley was densely forested with oaks and pines. Immediately after the construction of the railroad grade, contract was awarded to cut down and burn all the wood and brush at $2.95 per cord in the floor of the Valley. In this manner 880 acres of the reservoir bottom were cleared for $50,000.

Wages. In the early part of the work laborers were hired at the Charter rate of $3 per day. It was thought that the main aqueduct could be completed for $60 a foot. Due to the draft of four millions of men into our Army and Navy in the war period, the labor supply became restricted, wage prices were tilted, and tunnel costs proportionately increased.

Hetch Hetchy Aqueduct. The location of the aqueduct was made in the light of careful engineering studies. The first consideration was given to the permanence of the necessary structures and the safety of the same commensurate with reasonable economy.

CHAPTER XI

The Main Aqueduct

THE aqueduct commences at Early Intake and falls on a grade of eight feet per mile to Priest Reservoir, a distance of 19 miles. The water is permitted to flow in the Tuolumne streambed from O'Shaughnessy Dam down to Early Intake, a distance of 12 miles. This will continue for many years to come until it is considered economically desirable to bring the water down by tunnel conduit and generate additional power at Early Intake.

The tunnel in granite is mostly of the horseshoe shaped section and lined with concrete. Its average diameter is 10 feet 3 inches and its average daily capacity 450 million gallons. In 1917 bids were invited for the construction of the 19-mile aqueduct. In the light of current wages the bids were deemed excessively high and therefore rejected. The City then proceeded to do the work by day labor and succeeded in establishing very efficient records by this means. Due to limited funds, work was prosecuted slowly from only three headings until February, 1920, whereas if abundant funds had been available work would have been conducted with desirable speed from perhaps 14 headings.

Due to war-time conditions, the Department then recommended receiving bids on a cost-plus-percentage basis, and the contract required a guarantee on unit costs in the various classes of the work so that they would not exceed a maximum price over that named by the contractor in his bid. This protected the City from unduly costly work, the contractor's fee being a definite amount, and not a percentage of the cost of the work.

An ordinance was adopted by the Board of Supervisors providing that if the work be let on a cost-plus-fee basis all payrolls and material bills would be approved by the City Engineer and the Board of Public Works, and paid directly by the City.

On April 21, 1920, the lowest bid received on a flat price was $9,901,520, whereas on the cost-plus-fee basis the guaranteed price was $7,802,952. On this basis the contract was awarded to the Construction Company of North America. The validity of the contract was immediately attacked in court and the City won in the legal controversy. On May 17, 1920, the City turned over its organization of construction forces to the Construction Company of North America, which assumed the direction of the work under contract No. 77-C, and completed the contract in 1925, including 19 miles of tunnel aqueduct from Early Intake to Priest Portal. The work of concrete lining the tunnel was performed by Messrs. Webb & Cox of the Universal Concrete Gun Company under sub-contract from the Construction Company of North America.

On October 25, 1924, Acting Mayor Ralph McLeran, wanting to do cheap politics, issued a stop order, which blocked the rate of progress of 260 feet a day on which the lining was being done. I hired as counsel Mr. Frank English and appealed to Superior Judge W. P. Johnson and had McLeran's stop order dissolved, which allowed the entire final completion of the work by June 30, 1925.

Final payment to the Construction Company of North America was $8,757,844.52.

CHAPTER XII

Power Features and Disposal Problem

FROM the conception of the plan of bringing water into San Francisco from the Hetch Hetchy Valley it was evident that considerable hydro-electric power could be cheaply generated by utilizing the difference in elevation between the various divisions of the work. Under the Raker Act the City has been obliged to develop this energy which otherwise would be lost to the whole community.

The following newspaper articles give considerable detail of the story. The first is an article which appeared in the *San Francisco Examiner* of June 16, 1918.

66,000 H. P. NEEDED FOR WAR WORK IS RUNNING TO WASTE ON CITY PROJECT

City Engineer O'Shaughnessy tells of enormous work being done, but the City needs millions to bring it to completion.

Power to run all street cars, operate factories, light streets and homes, drive riveters in ship plants to be harnessed.

Power sufficient to drive all the wheels of industry in San Francisco—this is the amount of "juice" that is running to waste through the Hetch Hetchy Valley. That explains why municipal officials and particularly City Engineer O'Shaughnessy are so desirous of selling sufficient Hetch Hetchy bonds to complete that part of the construction that will make this force available.

In the parlance of the engineer, it is estimated that 66,000 horsepower of electric energy will be available when the Hetch Hetchy Dam is completed. It has been estimated that one horsepower is equal to the power of ten men, which means that there is continually slipping away, night and day, winter and summer, more than the total physical strength of the entire population of this City, counting men, women, boys, girls, and babies as full-grown laborers.

It is almost impossible to visualize this enormous force. The power to operate all of the street cars; to run all the mills and factories, to light the streets, homes, and office buildings, run the elevators, drive the hammers that rivet the bolts in the ships and steel buildings, turn the revolving mixers that grind out the concrete for the pavements and reinforced buildings—in short, to do everything from the heating of an electric pad for the sick patient to the hoisting of the tons of granite or steel at the end of an electrically driven crane.

No wonder Mayor Ole Hanson, of Seattle, talked with pride to the Supervisors last Monday of the municipally owned power plant, where they furnish "juice" to shipbuilding plants in Seattle at half the cost it can be purchased for here at wholesale. He argued that the City that can supply power the cheapest is the one that eventually will get the business. And then he remarked:

"Take my advice and give that old-baldhead-Irishman, O'Shaughnessy, all the money he needs for the development of your power in Hetch Hetchy. For if you don't, mark my word, we will take the business away from you."

And efforts are being made to secure the sale of enough bonds to speed up the work of construction. Meetings have been held with bankers to see what arrangements can be made. With the War call for all the energy and power of the country, it is believed that unusual efforts should be made to furnish sufficient money to harness this immense force slipping away to the sea.

To explain in detail what the City is proposing to do at the Hetch Hetchy to develop the power

possibilities, City Engineer O'Shaughnessy, on request of *The Examiner*, on *June 16, 1918*, wrote the following article:

"$15,000,000 NEEDED TO HARNESS GREAT FORCE

"By M. M. O'Shaughnessy, City Engineer

"In connection with the visit of Mayor Ole Hanson of Seattle last Monday to the City of San Francisco, some interesting disclosures were made as to the success of municipal ownership of power plants for lighting facilities and other purposes in the city of Seattle. The power is sold at about ½ cent per kilowatt hour, and it is now proposed to spend $5,000,000 in constructing a power plant on the Skagit River, 100 miles away from Seattle, to bring additional power to the city for manufacturing and other uses. "About 360,000,000 kilowatt hours of electricity are now consumed in San Francisco annually, divided as follows:

	Per Cent
Street railway system	63.6
Street lighting	2.23
Commercial lighting	9.42
Commercial power	21.2
Unaccounted	3.55

"The uses of power fluctuate during the 24 hours, the maximum being generally at the peaks of the street railway uses about 8 o'clock in the morning and 5 o'clock in the evening. From midnight until early morning there is very little consumption of power by the street railway companies. The average load throughout the 24 hours is 40,000 kilowatts, while the peak load goes up to as high as 95,000.

"LOS ANGELES REVENUE $700,000

"The City of Los Angeles has developed 35,000 horsepower from its aqueduct water supply, for which it gets a revenue of about $700,000 a year from the private corporations to which it supplies current. These corporations own the distributing system inside the city, the cost of which is beyond the financial capacity of the city to acquire, hence the above arrangement. Los Angeles could not develop any power until it had a length of 200 miles of aqueduct completed, and a capital expenditure of $27,000,000 had to be made before any financial returns were possible.

"San Francisco is more fortunately situated in this respect, as with the completion of eighteen miles of mountain aqueduct and the construction of impounding dams, this commodity can at once be made available, and a revenue derived from the sale of power which will more than pay interest on the money invested in that portion of the Hetch Hetchy Project.

"Due to the failure to sell enough bonds last year, the project is progressing at a slower rate of speed than could be obtained if adequate funds were available. If $15,000,000 were provided in the next three years, power could be delivered in San Francisco in 1921, and if sold at the prices which the City is now paying for electricity for its Municipal Railway, namely, 1 cent per kilowatt hour, a handsome revenue will be obtained from this portion of the City's enterprise.

"The introduction of this power would have an incalculable value in accelerating the rate of growth and development of San Francisco, in promoting the shipbuilding industry, and more especially in the task of providing for the manufacture of armament and equipment for the United States Government, to aid in bringing the war to an early termination.

"Although very limited funds have been made available to the City Engineer to carry on this great work, nevertheless immense strides have been made during the past year on the Hetch

Hetchy development. San Francisco is now producing at its Early Intake power plant 4000 hydro-electric horsepower, for construction operations on the remainder of the Mountain Division. Work is in progress at five different points along the great eighteen-mile tunnel aqueduct. The equipment for this tunnel has been purchased, and all the men that can efficiently be used with the amount of money available are at work in boring through the granite mountains a passage for the 400,000,000 gallons of water daily that will be taken from the upper Tuolumne and lead to the regulating reservoir on Priest Hill above the projected Moccasin Creek Power House.

"66,000 HORSEPOWER

"From this reservoir, at an elevation of 2170 feet to 888 feet, the water will drop through a penstock line, a vertical distance of over 1282 feet, and its tremendous impact will be converted in the power house into 66,000 horsepower of hydro-electric energy.

"At Lake Eleanor a dam will be completed by July of this year to provide storage during the dry season for the Early Intake Power House. The dam is 1150 feet in length and sixty feet in height. It is a buttressed arch structure, of a design involving several original features. There are twenty-two arches, each with a span of forty feet, supported by heavily reinforced buttresses and a straight gravity section which serves as a spillway.

"To provide the million board feet of lumber necessary for the forms for this structure, a sawmill was erected at Lake Eleanor, in addition to the large Canyon Ranch sawmill which the City owns, and is now operating in the Hetch Hetchy project.

"With the completion of the Eleanor Dam next month, the level of Lake Eleanor will be raised over thirty feet. Water, which will be released through the gates of Eleanor Dam, will pass down the channel of Eleanor Creek to its confluence with Cherry Creek, thence will flow in the channel of the latter stream to the diversion works, whence it passes into the Cherry Creek aqueduct, completed several months ago. This conduit has a capacity of 200 second feet; is 3.3 miles in length, and consists of 1.3 miles of open ditch, 1 mile of flume and 1 mile of tunnel. The water falls 343 feet through the penstock pipes to the power house, where 4000 horsepower of electrical energy is generated.

"A transmission line, 19 miles in length, has also been completed, and this feeds the current at a voltage of 22,000 to all shafts and adits along the 10½-foot tunnel aqueduct where construction work is being carried.

"HETCH HETCHY ROAD RUNNING

"The Hetch Hetchy Railroad, 68 miles in length, has been completed with the exception of some of the track ballasting. The line is now in operation—two locomotives haul about six carloads of cement and construction materials over the line daily.

"A privately operated sawmill has been constructed adjacent to the Hetch Hetchy Railroad. It will furnish freight in the shape of five carloads of timber backhaul each day, and numerous other timber holdings in the immediate vicinity will start operation in the near future, so that practically all the cars that are used in hauling freight for the Hetch Hetchy development will return loaded with income-producing freight.

"Independent of its use as a domestic water supply, in which respect it will be unsurpassed, the Hetch Hetchy development should be prosecuted most vigorously, and the Mountain Division thereof rushed to completion as fast as money can be efficiently expended on its construction. If this is done, the future of San Francisco is assured—if it is not done, the bankers, real estate operators and business men of this community will have only themselves to blame for the gradual drifting of business enterprises to other points, for their neglect to get behind this project and with unity of spirit and concerted action help finance its construction. The development is a patriotic

one in the highest sense, as was indicated by Secretary Lane on his recent visit to San Francisco, when he promised to cooperate in every way to advance the Hetch Hetchy construction.

"The City Engineer has an efficient construction force of 600 men at work in the mountains. This will only be a nucleus of the number employed if the funds for the development are furnished. Every foresight has been exercised in the design of the structures for this development and in organizing a force to build them. No unforeseen difficulties can impede the work and no adverse interests can delay it if San Franciscans stand together in backing this project.

"Existing enterprises have little to fear from the City's competitive activities as the demands for power in Northern California are increasing annually at the rate of 70,166 horsepower. There is now a great deficiency of equipment and output. Many streams are unharnessed which could be put to use and a great economic waste is thereby committed. Oil and coal vitally needed for the navy and maritime commerce are consumed in steam plants, while water is wasting to the ocean unutilized. It is the highest type of conservation to develop power from the mountain streams because, after passing through the turbines, the released water can be used for irrigation and other purposes and serve to bring land, which is now wasted, into use.

"After the first large unit is developed on the Hetch Hetchy project, several others may be developed in the future, as the development of San Francisco and the adjacent San Mateo territory demands, as undoubtedly at an early date there will be a consolidation of those communities."

On June 18, 1918, I addressed the following letter to the *San Francisco Examiner*. This was subsequent to the visit of Ole Hanson, the Mayor of Seattle, who spoke of the great value of developing power on the Hetch Hetchy project.

Editor, *San Francisco Examiner*,
San Francisco.

Dear Sir: In response to your request as to the policy of the City of San Francisco contemplating power development in connection with its water supply project, I desire to state that on January 4, 1910, by a vote of 32,886 for and 1609 against, the citizens of San Francisco voted $45,000,000 to build a water supply from sources including Lake Eleanor and waters of the Tuolumne River and tributaries.

In the tentative plans on which the bond issue was based several power installations were incorporated as a part of the project.

The only right the City had from the United States Government at that time was from the Garfield Permit of May 11, 1908, which permitted the City of San Francisco to develop first Lake Eleanor as an earlier unit of construction, and subsequently develop Hetch Hetchy. Secretary Ballinger, who succeeded Secretary Garfield, proceeded to revoke that portion of the permit granting the City the right ever to use Hetch Hetchy for a reservoir, and an expensive controversy to the City was developed which compelled San Francisco to spend about $250,000 in engineering plans and data in order to show cause why the Hetch Hetchy portion of the permit should not be revoked. The subsequent hearing before Secretary Fisher in November, 1912, resulted in no decision for the City, and finally the municipal authorities, becoming dissatisfied with the treatment imposed by the Washington Bureaus, decided to get a straight grant from Congress, which was secured by the passage of the Hetch Hetchy Bill through the House of Representatives and Senate and the final confirmation by President Wilson December 19, 1913, which secured for San Francisco for all time the right to water and power development on the 420,000 acres, the mountain portion of the Tuolumne watershed, which is partially included in the northern portion of the Yosemite National Park.

The City and County of San Francisco had many antagonists in endeavoring to get this bill

passed, including nature lovers, irrigationists, rival water schemes, water companies and rival power schemes, and amongst the many conditions imposed upon the City in securing the grant was the mandatory condition (under paragraph M, 5th Section of the Act), which said:

"The said grantee shall within three years from the date of completion of said portion of the works install, operate and maintain apparatus capable of developing and transmitting not less than ten thousand horsepower of electric power for municipal and commercial use, said ten thousand horsepower to be actually used or offered for use; and within ten years from the completion of said portion of the works not less than twenty thousand horsepower; and within fifteen years therefrom not less than thirty thousand horsepower; and within twenty years therefrom not less than sixty thousand horsepower, unless in the judgment of the Secretary of the Interior the public interest will be satisfied with a lesser development."

Apart from the declared policy of the citizens in voting their bond issue to include power plants as well as water as a part of the same, it may thus be seen that the Federal authorities in Washington, clearly alive to public interests, make it mandatory on the City of San Francisco to proceed with the power development and not sit idly by on a natural resource and deprive somebody else of the opportunity of developing same.

The wisdom of this policy cannot be questioned. Oil and coal and other valuable fuels are now being burned and wasted, while nine-tenths of the available horsepower from waterfalls in California is also permitted to be recklessly wasted.

Since the passage of this bill five years ago, the City of San Francisco has made phenomenal advances in the development of its public utilities. We now lead any city in the United States in the successful construction and operation of municipal railways, for which a large amount of power is necessary. What, then, can be more logical than that the officials of San Francisco, always alive to the interests of the City, are using all their energies to bring some of those resources into its use.

Our City water supply is so fortunately situated in high altitudes in the mountains that power drops along the line of the aqueduct flow from the mountains to the sea automatically supply the power product without much extra expense other than for machinery, equipment and pole line transmission. The first power plant naturally will be developed where the first large drop in the aqueduct takes place near Priest's, and when the entire power output from this drop is consumed, other falls may be availed of in other portions of the watershed, which will more than take care of the municipal needs of San Francisco and enable the City to sell at a profit on the whole project the excess power which it does not need.

Trusting this will give you the desired information which you request,

Very truly yours,

M. M. O'SHAUGHNESSY, *City Engineer.*

This brought forth the following article from the *San Francisco Chronicle,* which shows the divided state of mind of the San Francisco press with regard to the City's water project activities:

[*San Francisco Chronicle,* June 25, 1918]

EXPLANATION WHICH DOES NOT EXPLAIN

The Charter of This City Cannot Be Changed by Act of Congress

The City Engineer, in an effort to justify the expenditures now being made on a municipal power system, cites the Act of Congress authorizing the impoundment of water from the watershed of a national park and national forest, and which requires that within three years after the "completion" of any works suitable for the generation of electric energy the City shall install the

necessary machinery and sell the power developed, at cost, to such municipalities or irrigation districts as may need it, but not at any price to private persons or corporations.

Now, the fact is that the grant of the use of land in the national forest and national park was a grant for a source of water, the obligation to generate power being merely an incident.

And it is also the fact that in accordance with the Charter the people of this City voted bonds to the amount of $45,000,000 to bring water to the City, with the development of power as an incident.

And yet all pretense of using Hetch Hetchy as a water source has been completely abandoned by the City authorities, at least "for the present generation", and nobody knows what the next generation will do. There is no longer anything said of Hetch Hetchy by anybody as a source of water supply.

Therefore, not a dollar can be lawfully expended from the Hetch Hetchy fund for the development of power.

And if it be said that the statute making the grant requires the development of power—which it does not until three years after the "completion" of the dam—then the answer is that the Charter of this City cannot be amended by Act of Congress or the unlawful expenditure of municipal funds justified.

In fact, the law does not pretend to do so. On the contrary, the grant is made only for use in accordance with the laws of this State or ordinances of this City.

Whether bonds whose intended use was to be notoriously contrary to the purpose for which they were voted would be held valid by the courts we do not know. It is a question that is not unlikely to arise. But it is certain that public officials who deliberately expend public money for purposes other than those for which it is appropriated subject their bondsmen to a very grave risk.

What this City needs to develop is not power, which we can buy for less than our cost of production, but water, which we cannot buy at all to the extent of our requirements.

What do the authorities propose to do about water? This is the important question. And it would be better if they would direct their attention to that instead of puttering about development of power to be sold at a loss years before there is any requirement under the grant that we shall develop any power whatever.

By 1922 the water development work had progressed to the point where it was necessary to commence actual work on the Moccasin Plant. This work was placed in the hands of the following men, who had been on my staff for many years:

R. P. McIntosh, Hydraulic Engineer
Reuben J. Wood, Structural Engineer
Paul J. Ost, Electrical Engineer

Mr. H. A. Minton, Architect, was specially employed to design the power house building, the first six cottages, the clubhouse, and the schoolhouse of the permanent village. Mr. John Davis Hatch, Architect, was later employed to supervise the construction work and design additional cottages, etc.

It is to be regretted that both Mr. McIntosh and Mr. Wood have since died while in their prime.

Power House Building. The building is a steel frame structure with massive concrete foundations set on bedrock and reinforced concrete walls and roof. The length is 225

feet and the width 98 feet. The south end of the building is so constructed that it may be removed and the building extended southerly to house two additional generators. The height is 67 feet above the main floor, with a 15-foot basement below.

The architecture is distinctly the Mission style and has been well carried out and equipped for the purpose. The roof is covered with red tile and arcades on either side of the building serve on the one end to house the 36-inch hydraulically operated gate valves and on the other hand to shelter the grills in the floor which admit cooling air to the generator pits. This arrangement of air intakes and baffle plates permitted the lowering of the power house floor sufficiently to provide enough additional power to more than pay interest on any slight additional cost of construction.

Water Wheels. The water wheels are of local manufacture of the double overhung impulse type, the single runners being rated at 12,500 h. p. (25,000 h. p. generating unit) for maximum efficiency with an overload capacity of 10 per cent.

Two governors are provided for each generator unit, one for each runner, and speed regulation is maintained by means of needle nozzles, each of which is fitted with an auxiliary nozzle which may be operated either as a water-saving device or as a synchronous bypass. Each main unit has its individual oil pressure set supplying oil under 150 pounds pressure to actuate the governors, although each has capacity to handle two generator units.

The following features make for simplicity of operation: the speed can be raised or lowered from the switchboard; the units can be completely shut down from the switchboard. Special mechanical arrangements permit shifting from hand control to automatic control by moving only one lever. A further refinement caused both the automatic and hand control mechanism to be synchronized so that the change from one form of control to the other can take place without undue oscillation of the governor or change in water-wheel speed. Large yellow enameled indicators actuated by the governors permit the operator to observe the position of the needle nozzle from the switchboard gallery. The pits around the governor mechanisms are covered with Irving subway grating, thus making the action of the servometer visible from the operating floor. This construction also admits daylight and air into the pits. The nozzle mechanism and generator pits are also readily accessible from the basement.

The Pelton Water Wheel Company supplied the water wheels, governors and their auxiliaries.

Generators. The four generators are each of 20,000 kv.-a. capacity generating at 11,000 volts, 257 r. p. m. The generator rotor is mounted on the shaft between the two water-wheel runners. Two cast-steel flywheel elements, machined to receive the poles, form the spider. A sheet-steel housing causes air to be taken from the arcade outside the building through the pit under the generator and to be forced through the windings and the stator frame into the generator room. Each unit requires 60,000 cubic feet of air per minute under full load conditions. A monitor and louvres in the roof provide ample outlet for the heated air from the generator room.

As indicative of the rate at which water wheels and generators are increasing in size, it is interesting to note that when this project was first studied, units of 12,500 kv.-a. capacity were the largest obtainable. However, when the time came actually to place the order for the machines, 20,000 kv.-a. units were readily to be had.

One unit of this size has capacity for charging an unloaded transmission line, the line requiring approximately 17,000 kv.-a. at 150 kv. The characteristics of the generators are such as to prevent their being self-exciting when carrying this load. This makes it possible to put a single generator on a transmission line and gradually build up the voltage without exceeding the desired voltage at the delivery end of the line.

The generators were furnished by the General Electric Company.

Transformers. The transformer installation consists of four banks of three 6667-kv.-a. single phase units and one spare. The voltage rating of the transformers permits of stepping 11 kv. delta to either 115 or 154 "Y" with taps for voltage increases up to 5 per cent on the high side. They are of the oil insulated, water-cooled type, fitted with cooling water and temperature alarms which register on the switchboard. Each transformer is fitted with pipe connections for draining, filling and filtering the oil.

Cooling water is pumped from the tail-race rather than use the water from the penstocks, effecting an economy in power production of 60 kilowatts under full load condition.

The transformers were furnished by the Westinghouse Electric and Manufacturing Company.

Regulators and Switchboards. The generators are controlled from the switchboard located at one side of the center of the building. The design of the plant contemplates that a generator with its associated bank of transformers will be operated as a unit. Units will be connected only on the high side of the transformers. This arrangement does away with a complicated system of 11-kv. switches and busses and materially simplifies the whole power house layout. One 11-kv. bus is provided in the power house—normally only one of the four generators is connected to it for the purpose of furnishing power for use in the plant and in the camp. The arrangement, however, permits any generator or group of generators to be connected to any transformer bank or group of transformer banks.

A Westinghouse broad-range type of regulator is provided for the exciter of each generator, and for a spare motor generator exciter which has sufficient capacity to supply excitation to two generators. Field control boards for all units have been placed on the main floor adjacent to the exciters.

Switching Apparatus. Owing to the almost ideal topography at the power house site, it was possible to conveniently install all of the transformers, high-voltage switches and busses outside the power house. The 11-kv. leads from the generator switches are carried overhead on a steel structure from the building to the low-voltage bushings on the transformers. From the high-voltage bushings the power may be connected to either of two high-voltage busses.

These high-voltage busses connecting the transformers to transmission lines are of 750,000 circ. mil. stranded copper. High-voltage connections for individual units are made of standard 2½-inch wrought-iron pipe. Connections for the transmission lines are made of 2½-inch extra heavy pipe. As far as possible, air-brake switches were substituted for high-voltage oil switches, at an appreciable saving in cost. This necessitated a very careful arrangement of interlocks between switches, and, as a further precaution, a very complete arrangement of semaphore signals and light signals has been installed to prevent the incorrect operation of a switch by hand. All of the air-brake switches, with the exception of the bus sectionalizing switch, are power-operated direct from the switchboard.

A lookout window in the rear of the power house, readily accessible from the switchboard room, permits the operator to overlook the switch yard and penstocks.

Transmission Lines. Two transmission lines leading toward San Francisco connect to the high-voltage busses at the present time. In the future, power from the upper plants will be transmitted over two other lines into the same busses, at which time the number of transmission lines from Moccasin to the Bay region will have been increased to four, making a total of six lines handled by the Moccasin busses.

The two lines at present installed are carried on 506 double circuit, galvanized steel towers, 98 feet in height, over the 98½-mile stretch between Moccasin and the Pacific Gas and Electric substation at Newark. The route selected for the towers crosses the San Joaquin Valley on an air line going due west, three miles north of Modesto. The right-of-way is 110 feet in width, the first line of towers being constructed within 20 feet of the north side thereof. The right-of-way is wide enough to include space for three water-carrying aqueduct pipes and a second line of towers. The lowest crossarm is 62 feet above ground level. Conductors of each circuit are spaced 15 feet apart vertically. The horizontal distance between the wires at the top and bottom crossarms on the tower is 24 feet and at the middle arm 28 feet. Average spacing between towers in level country is 950 feet, while the spacing in the rougher country varies from 350 to 2212 feet. No very cold weather is experienced and the line has been strung for a maximum tension of 5000 pounds at 20 degrees (F.), with a side wind pressure of 8 pounds per foot. This results in a normal tension of from 3000 to 3700 pounds in the line under average temperature and wind conditions.

On that portion of the line at a distance from the salt fogs of San Francisco Bay, a 397,500 circ. mil. steel-reinforced, aluminum cable supplied by the Aluminum Company of America has been installed. But in the vicinity of the bay nine miles of line are strung with conductors of stranded copper with hemp core having a copper cross-section of 345,000 circ. mils. This gives a conductor of ¾-inch external diameter, which is necessary in order to prevent excessive corona loss when operating at 154 kv. This copper conductor was supplied by the Anaconda Copper Mining Company.

Four types of transmission towers are used in the line. These are classified as follows: standard towers, for normal conditions of stress and spacing; heavy duty towers, for angles, points of heavy pull and railroad crossings; switch towers, for accommo-

dating air-brake line sectionalizing switches; and transposition towers. Towers are of galvanized steel and were supplied by the Pacific Coast Steel Company, South San Francisco.

On standard towers, suspension insulation consists of 10 Westinghouse No. 601 units. On heavy duty towers at dead ends 12 Westinghouse No. 631 units are used and on heavy duty suspension strings, 10 of the same insulators. As far as possible dead-end construction was avoided.

No telephone line has been built in connection with the transmission circuits. At the present time the commercial toll service is being used in dispatching. Eventually it is the intention to use a carrier current system for communication between the generating and receiving points.

On August 14, 1925, the first unit of the Moccasin Power House was synchronized with the Pacific Gas and Electric system and commenced the delivery of power. Additional units were added during the next few days so that the full output of the plant was shortly flowing through the transmission line.

POWER DISPOSAL

The foregoing gives quite a complete description of the power features of the project; the story, however, would not be complete without telling some of the difficulties experienced in making satisfactory arrangements to dispose of the output of the plant.

The question of how best to dispose of the power generated at the Moccasin plant was before the Board of Supervisors for a considerable period of time. The City Engineer transmitted official reports to them on *April 4, 1923*, and again on September 11th of the same year. Excerpts from these reports are quoted as follows:

> As between the construction of an independent distributing system and the acquisition of the existing distributing system, there can be, I believe, no argument in favor of constructing an independent system in a competitive field, as against the acquisition of the existing systems, with their developed markets. An independent system should be considered as a last resort in the event that the existing systems could not be acquired, either by negotiation or condemnation proceedings within a reasonable period of time, during which our power plant was not producing revenue.
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> . . . . . .
>
> Notwithstanding the efforts of the City Attorney to hasten the pending gas rate litigation involving valuation of gas properties in San Francisco, over six years have been consumed in trial and appeal. Should it appear that possession of the distributing systems cannot be obtained for some considerable period after completion of the Moccasin Creek plant, I would recommend, pending securing such possession, that your Board arrange for the marketing of the power either through the agency of the existing companies in San Francisco or in any other possible way which can be arranged.
>
> Any such arrangement should terminate automatically upon securing possession of the properties and should be so drawn as to conform with all legal requirements.
>
> Failure to provide for such temporary disposal of the Moccasin Creek power output when the plant is ready for operation will, on the basis of the offers made by the power companies, subject the taxpayers of San Francisco to an annual loss of not less than $2,000,000.

On September 17, 1923, His Honor, Mayor Rolph, appointed an advisory power committee on power to aid in the solution of the problem. The following were the members: James D. Phelan, Justice Matt I. Sullivan, Judge F. J. Murasky, Major Chas. H. Kendrick, and Henry F. Boyen.

On October 8, 1923, the Board of Supervisors passed Ordinance No. 6013 requiring that the Board of Public Works, in accordance with the provisions of the Charter, furnish the Board of Supervisors with plans, estimates and cost of original construction of—

1. A distribution and standby plant for distribution of the output of Moccasin Plant.
2. The existing distribution and standby plants used by the Great Western Power Company in supplying energy to San Francisco, showing separately the portion of their plant acquired from Universal Electric and Gas Company.
3. The existing distribution system and standby plants used by the Pacific Gas & Electric Company in supplying electric energy to the people of San Francisco.

In compliance therewith the City Engineer on June 20, 1924, transmitted the following report to the Board of Public Works:

To the Honorable
The Board of Public Works of the
City and County of San Francisco.

June 20, 1924.

Gentlemen: In accordance with Ordinance No. 6013 (New Series), I submit herewith plans and estimates of the cost of original construction and completion as follows:

(1) Plans and estimates of the cost of original construction and completion of an electrical distributing system and standby plant sufficient for distributing in the City and County of San Francisco the electrical energy developed at the Moccasin Creek Power Plant of the Hetch Hetchy Project.

(2) Plans and estimates of the cost of original construction and completion of the existing distributing system and standby plants used by the Great Western Power Company in supplying electrical energy within San Francisco, including easements and other properties and rights owned in San Francisco and used or useful in connection with said system, showing separately estimates of cost of original construction and completion of the portion of the plant acquired from the Universal Electric and Gas Company.

(3) Plans and estimates of the cost of original construction and completion of the existing distributing system and standby plant used by the Pacific Gas & Electric Company in supplying electrical energy within San Francisco, including easements and other properties and rights owned in San Francisco and used or useful in connection with said system.

The several propositions follow in order:

I. ELECTRICAL DISTRIBUTING SYSTEM FOR MOCCASIN CREEK POWER PLANT

The cost of an electrical distributing system and standby plant sufficient for distributing in San Francisco the electrical energy to be developed at the Moccasin Creek Power Plant of the Hetch Hetchy project is estimated at $45,000,000, made up as follows:

Stepdown substation at end of transmission line, reducing the transmission voltage to a lower voltage, and cables and conduits for transmitting power at this lowered voltage through the City of San Francisco to substations	$ 3,500,000
Distributing substations, conduits, cables, services, meters, poles and conductors	30,500,000
Steam standby station	6,000,000
Lighting of streets	4,500,000
Miscellaneous equipment and headquarters	500,000
Total	$45,000,000

The distributing system covered by the above estimate is shown on the drawing Sheet 1, entitled "Municipal Distributing System, for Full Output of Moccasin Creek Plant."

The steam standby station covered in the above estimate is shown on the drawing Sheet 2, entitled "Municipal Standby Plant, Schematic Arrangement."

The distributing system and standby plant as contemplated in the above estimate and plans referred to would be competitive with those both of the Pacific Gas & Electric Company and the Great Western Power Company; it has been laid out in accordance with the provision of the ordinance to distribute the full output of the Moccasin Creek Power Plant of 80,000 kv-a, installed capacity, amounting to 214,000,000 k. w. h. per annum delivered to the consumers on the basis of 50 per cent load factor.

During the year 1923 the total amount of power delivered to consumers by the Pacific Gas & Electric Company and the Great Western Power Company in San Francisco was 280,372,617 k. w. h.

As pointed out in my report to the Board of Supervisors, dated September 11, 1923, "We cannot conceive of actually constructing a complete system such as the estimate was based on as an initial installation, for the very practical reason that there would not be a market to receive all of the power. The market could only be built up slowly if in competition with existing companies; this would take a number of years."

With the foregoing in mind I have planned an initial installation for a distributing system capable of taking care of our Municipal Railway, some of the public buildings, and some of the street lighting, and in addition such industries, business houses, and residences as could be conveniently served by the substations necessary to handle the Municipal Railway load. This initial installation would be such that it could be gradually expanded and extended to conform to the system for complete distribution covered in the foregoing estimate.

The cost of this initial installation is estimated at $15,000,000, made up as follows:

Step-down station at end of transmission line reducing the transmission voltage to a lower voltage, and cables and conduits for transmitting this lower voltage through the City to substations	$ 3,000,000
Distributing substations, conduits, cables, services, meters, poles and conductors	8,000,000
Steam standby station	3,000,000
Street lighting	600,000
Miscellaneous equipment and headquarters	400,000
Total	$15,000,000

This initial distributing system is shown on the drawing Sheet 3, entitled "Municipal Distributing System for Initial Development."

The steam standby plant for this initial development would require only one of the 35,000 k. w. generating units shown on the drawing Sheet No. 2.

This initial system, as has been pointed out, will not distribute the entire output of the Moccasin plant, nor will it serve the entire City. The territory which it is planned to serve is that contiguous to the Municipal Railway substations, the location of these substations being shown on drawing Sheet No. 4, entitled "Municipal Distributing System, Municipal Railway Lines," from which the greatest revenue can be derived.

The amount of load which this system would be called upon to distribute initially is problematical; it would include the requirements of the Municipal Railway system to an amount not exceeding 40,000,000 k. w. h. per annum, municipal light and power to the extent of 1,000,000 k. w. h. and street lighting to the extent of 1,500,000 k. w. h.; or, 42,500,000 k. w. h. per annum of municipal load. To this amount should be added such load as can be developed or taken from the present operating utility companies. During the first year the total electrical energy delivered would certainly not exceed 60,000,000 k. w. h. for all purposes. This delivery might reasonably be expected to increase at the rate of 5,000,000 k. w. h. per annum during the first few years. The expense of providing for this increase will range between one and two million dollars annually, depending upon the extent to which the main trunk system and substations have to be extended to care for the new business.

The foregoing estimate of the cost of an initial distribution system contemplates the construction new of the works to be included therein. It is entirely possible that in lieu of a part of such new construction it would be possible to acquire from the Pacific Gas & Electric Company or the Great Western Power Company, or both of them, either by voluntary agreement or through eminent domain proceedings, such portions of their plants as could be satisfactorily incorporated into said initial distributing system. In the latter event a portion of the new construction would be necessary.

I therefore recommend that if a bond issue be submitted for the purpose of acquiring or constructing such initial plant, its designated purposes be made broad enough to cover construction in whole or in part or acquisition in whole or in part of the works necessary to said system.

II. ORIGINAL CONSTRUCTION, GREAT WESTERN POWER COMPANY

The cost of original construction and completion of the existing distributing system and standby plants used by the Great Western Power Company in supplying electrical energy to the inhabitants of the City and County of San Francisco as outlined in the Ordinance No. 6013 (New Series) is estimated at $9,000,000, made up as follows:

Distributing substations, conduits, cables, services, meters, poles, and conductors (including $800,261—value of Universal Electric & Gas property taken over)	$5,500,000
Steam generating stations (including $305,100—value of Universal Electric & Gas property taken over)	3,000,000
Miscellaneous utilization equipment (including $3,488—value of Universal Electric & Gas property taken over)	200,000
General and Miscellaneous (including $12,744—value of Universal Electric & Gas Co. taken over)	300,000
Total	$9,000,000

In view of the fact that Ordinance No. 6013 (New Series) limits the estimate to the cost of original construction, these figures are based on the reproduction cost of the property, without any deduction being made for depreciation, nor has any amount been included for severance damage.

They do not therefore represent the valuation which would be set up for purposes of purchase or sale, or under condemnation proceedings.

The estimate covers, in accordance with the requirements of the ordinance, the existing plant of the company, including one-half the value of the Universal Electric & Gas Company's property taken over by the Great Western Power Company. It also includes certain property used by the company which I do not consider desirable for the City to acquire and which has been excluded in the condemnation proceedings already instituted by the City Attorney's office.

The distributing system of the Great Western Power Company is shown on the drawing Sheet No. 5, entitled "Great Western Power Company's Electric Distributing System," which shows the steam generating stations, the substations, and the territory served. Due to the amalgamation of the Universal Electric & Gas Company's system with that of the Great Western Power Company and the Pacific Gas & Electric Company, it has not been possible to show separately the portion of the system acquired from the Universal Electric & Gas Company, as required in the ordinance.

The primary distribution through a large part of the City is by 11,000-volt overhead circuits. This method of distribution is one which I do not consider desirable on account of the high voltage employed, and is one which the City should not adopt for a distributing system of its own.

The drawing Sheet No. 5 indicates the territory served by the Great Western Power Company. It should be pointed out, however, that the company does not furnish all of the electric energy used in the territory indicated as served, as the business is divided with the Pacific Gas & Electric Company, which straddles the same territory.

III. ORIGINAL CONSTRUCTION, PACIFIC GAS & ELECTRIC COMPANY

The cost of original construction and completion of the existing distributing system and standby plant used by the Pacific Gas & Electric Company in supplying electrical energy to the inhabitants of the City and County of San Francisco, as outlined in the Ordinance No. 6013 (New Series) is estimated at $23,500,000—made up as follows:

Distributing substations, conduits, cables, services, meters, poles, and conductors (including $800,261—value of Universal Electric & Gas Company property taken over)	$16,000,000
Steam standby station (including $305,100—value of Universal Electric & Gas Company property taken over)	6,000,000
Utilization and street lighting equipment (including $3,488—value of Universal Electric & Gas Company property taken over)	1,000,000
Miscellaneous equipment and office property (including $12,744—value of Universal Electric & Gas Company property taken over)	500,000
Total	$23,500,000

These figures, as in the case of the Great Western Power Company's distributing system and for the same reason, are based on the reproduction cost of the property without any deduction being made for depreciation, nor has any amount been included for severance damages.

The estimate does not include property used jointly for gas distribution, nor property and equipment in San Francisco, used in constructing, maintaining, or operating the company's electric, gas, water or railway systems outside of the City and County of San Francisco.

The estimate includes certain property used by the company, which I do not consider desirable for the City to acquire, and which has been excluded in the condemnation proceedings already instituted by the City Attorney's office.

The distributing system of the Pacific Gas & Electric Company is shown on the drawing Sheet No. 6, entitled "Pacific Gas & Electric Company's Electric Distributing System," which shows the steam standby station and substations within the City.

The Pacific Gas & Electric Company now operates and maintains a step-down station in San Mateo County, just south of the southern boundary of San Francisco. This station, which is known as the New Martin Substation, is used to reduce the voltage used in transmission to that of the primary distribution. It is shown in its relation to the San Francisco Distributing System of the company on Sheet No. 6. Between Newark Substation and the New Martin Substation the company has a high voltage double circuit transmission line on steel towers constructed along the Bay Shore. Should San Francisco acquire the distributing system of the Pacific Gas & Electric Company within the City limits, the company would not have further use for either the New Martin Substation or the transmission line. Both the substation and transmission line would be useful to the City and if not taken over with the distributing system would, without doubt, be a large element in the severance damage allowance.

The estimated reproduction cost of the transmission line and the New Martin Substation is $1,000,000, which amount should be added to the estimated cost of the distributing system if the transmission line and substation are to be included therein, making the total for the Pacific Gas & Electric Company's distributing system $24,500,000.

The New Martin Substation and the transmission line are shown on the drawing Sheet No. 7, entitled "Pacific Gas & Electric Company's 110 k. v. Transmission Line and Substation on West Shore of San Francisco Bay."

PLANS

Plans of the several distributing systems, stations and appurtenant matters designated in the Ordinance No. 6013 (New Series) are presented herewith on eight sheets, each bearing the general title:

PLANS FOR
ELECTRIC DISTRIBUTING SYSTEM
AND STANDBY PLANT
CITY AND COUNTY OF SAN FRANCISCO

PREPARED UNDER ORDINANCE NO. 6013
BOARD OF PUBLIC WORKS
M. M. O'SHAUGHNESSY, CITY ENGINEER

Sheet No.	Title
1	Municipal Distributing System, for Full Output of Moccasin Creek Plant.
2	Municipal Standby Plant, Schematic Arrangement.
3	Municipal Distributing System for Initial Development.
4	Municipal Distributing System, Municipal Railway Lines.
5	Great Western Power Company's Electric Distributing System.
6	Pacific Gas & Electric Company's Electric Distributing System.
7	Pacific Gas & Electric Company's 110 k. v. Transmission Line and Substation on West Shore of San Francisco Bay.
8	Present and Possible Future Districts Requiring Underground Electric Distribution.

Respectfully submitted,

M. M. O'SHAUGHNESSY,
City Engineer.

On May 26, 1925, the Citizens' Advisory Committee submitted a report to the Mayor as follows:

The Advisory Committee, at the request of the Mayor, has recently conferred with representatives of the Pacific Gas & Electric Co. concerning the temporary disposal of the electric energy generated on the Hetch Hetchy system.

The Committee has been impressed by the facts that the electric energy will be available for use within a very short time; that the Raker Act forbids the sale of power to private corporations or individuals for resale; and that, if any attempt is made to part with the City's rights, the City would be exposed to a cancellation of its grant in judicial proceedings instituted by the Attorney-General of the United States, upon the request of the Secretary of the Interior.

The Committee proposed to the officials of the Pacific Gas & Electric Company a plan by which the Hetch Hetchy power might be, without prejudice to the City's rights, distributed over the lines of that company to consumers, to be charged for at existing legal rates, all bills to be collected and accounted for by the Pacific Gas & Electric Company for a stipulated compensation, or a fixed price per unit of power handled, said compensation to the company to be determined by the Railroad Commission of the State of California. The plan proposed is substantially the same as that recently recommended by the Chamber of Commerce, the San Francisco Real Estate Board and the Downtown Association.

The company's officials have refused to enter into such an agreement. They have made a counter-proposition which involves the sale to the company of the entire output of electric energy generated at Moccasin Creek for the sum of $2,000,000 per annum, payable in equal monthly installments. This amount, which approximates one-half of one cent per kilowatt hour at Newark, the company has offered to pay subject to the following conditions:

(a) That the energy consigned from Moccasin Creek power house at Newark shall not be less than 420,000,000 kilowatt hours per annum at a 75 per cent monthly load factor. Payment to the City shall be increased or decreased proportionately as consignment of energy is above or below this amount.

(b) That if the present established rates for electric energy be increased, the payment of $2,000,000 to the City as proceeds of said consignment shall be proportionately increased, and if present established rates are decreased the payment of said $2,000,000 to the City as proceeds of said consignment shall be proportionately decreased.

By reason of the provisions of the Raker Act, which prohibits a sale of the Hetch Hetchy electrical energy to a private corporation or individual for resale, and the refusal of the company's officials to recede from their position, the Committee regrets to report that it has been unable to reach an agreement.

Whether or not any legal and financially desirable arrangement be hereafter made for the temporary disposal of the power, the Committee advises that all possible speed be given to the completion of a transmission system from Newark to San Francisco, and a distributing system in San Francisco, which, indeed, is absolutely and legally necessary in order to carry out the provisions of the Raker Act and establish the temporary character of any such arrangement, and protect the permanent rights and interests of the City in Hetch Hetchy power.

And we further advise that, if, in the future, a temporary agreement for the disposal of electric power is reached, that it first be approved by the Secretary of the Interior, upon the advice of the Attorney-General of the United States.

Acting under the instructions of the Advisory Committee, the City Attorney prepared a draft of an agreement which in his opinion was in correct legal form and

which did not conflict with any provisions of the Raker Bill. This was submitted to that body without the figures fixing the revenue basis. The Committee thereupon fixed the basis of revenue and the completed draft was formally submitted to the Pacific Gas & Electric Company by the Mayor on June 12, 1925.

The reply of the Pacific Gas & Electric Company made to the Mayor on the same day follows:

I am just in receipt of your letter of today accompanied by two drafts of agreement embodying the terms and conditions under which the City proposes to make temporary disposal of Hetch Hetchy power through the system of Pacific Gas & Electric Company. My associates and I are giving this draft immediate consideration, but cannot submit to you before Monday morning our complete report thereon.

There is, however, one feature of the proposed agreement upon which we can answer at once. That is the item of price. The form of agreement submitted fixes a price substantially in excess of $2,000,000 per annum, whereas we have repeatedly advised you and other representatives of the City that $2,000,000 per annum for the total output of the Moccasin Creek power house at Newark is the maximum sum we could pay.

On July 30, 1923, the Board of Supervisors passed a resolution inviting proposals for the total power output of the Hetch Hetchy project under a term contract, not to exceed ten years. That invitation was duly communicated to us, and by our letter of September 9, 1923, we offered $2,000,000 per annum.

At the time of the writing of that letter a relative dearth of power made the forthcoming Hetch Hetchy power production more valuable to the company than it now is, and if an offer for that power were now to be made by the company for the first time, the offer would be less than $2,000,000.

Furthermore, later negotiations disclosed that the City representatives desired not a term contract but a temporary contract, subject to cancellation on short notice.

Inasmuch, however, as the price of $2,000,000 was once named, the company determined to adhere to it, although all commodities fluctuate in market value from day to day and no one would ordinarily think of being bound to buy or sell on quotations made 20 months past, nor would anyone ordinarily deal at the same price for a temporary contract as for a term contract.

But in furtherance of our desire and purpose to be helpful to the City in which we have so largely an interest, we submitted to the Mayor's Advisory Committee on May 15, 1925, a proposed form of temporary contract for the purchase of Hetch Hetchy power, which counsel advised the company to be lawful and which the company was prepared to execute with the City. The contract fixed the price at $2,000,000 per annum, notwithstanding the changed conditions.

The sum per annum upon the terms stated in the company's proposal of May 15, 1925, to the Mayor's Advisory Committee, or similar terms, or terms akin, is all the worth the company can find in the Hetch Hetchy power, and it is not prepared and it cannot afford to pay any higher amount therefor.

As you know, our company is a large buyer of power as well as a large producer of power. We are now buying power at many places in Northern and Central California. Our contracts for the purchase of power have been examined and analyzed by competent representatives of the City. In no case do we pay more than we have offered for Hetch Hetchy power. As a rule we pay less.

Between midnight and morning and on Sundays and holidays, when little or no power is being used, we must pay for the power Hetch Hetchy is then turning out, even though there is no demand for it.

We are now producing power and delivering it at load centers for less than the price offered

for Hetch Hetchy power and can continue to do so. Our Pit River No. 3 plant will be completed next month. That plant will deliver to our system at Newark more power than the Hetch Hetchy output for substantially less money than we have offered for the Hetch Hetchy power.

The City is not willing to sell us Hetch Hetchy power as and when we need it, but requires us to take all its power; and we are dealing upon that basis. Our offer, therefore, is to take your entire output whether we can use it or not. If we do not take it, we pay for it just the same.

Please be assured, Mr. Mayor, of our purpose to assist in the present situation to the fullest extent, but we cannot pay more than a fair and adequate price.

Respectfully yours,

W. E. CREED, *President.*

This letter did not break off negotiations and by careful study of actual conditions it was possible to draw up the following contract between the Board of Public Works and the Pacific Gas & Electric Company. On June 29th the Board of Supervisors authorized the Board of Public Works to sign the contract, which was done by both parties on July 1, 1925:

AGREEMENT BETWEEN THE CITY AND COUNTY OF SAN FRANCISCO AND PACIFIC GAS AND ELECTRIC COMPANY

This agreement, made and entered into this first day of July, 1925, by and between the Board of Public Works of the City and County of San Francisco, acting for and on behalf of the City and County of San Francisco, a municipal corporation, hereinafter referred to as "City", under authority of the Board of Supervisors granted by Ordinance No. 6684 (New Series), the party of the first part, and Pacific Gas and Electric Company, a corporation, of San Francisco, California, hereinafter referred to as "Company", the party of the second part:

WITNESSETH:

Whereas, the City has now completed the construction of the Moccasin power plant as a part of the development of the Hetch Hetchy project, which plant has a rated capacity of 70,000 kilowatts and is capable of producing approximately 460,000,000 kilowatt hours of electric energy annually, and has also completed the building of a transmission line to the vicinity of Newark in Alameda County of sufficient capacity to transmit and deliver to that point approximately 420,000,000 kilowatt hours after allowance for transmission losses; and

Whereas, the City has not yet constructed or acquired a transmission line from the point near Newark to the City limits, and has not yet constructed or acquired a distribution system for utilizing the power produced at Moccasin plant and delivering the same for general municipal uses and for sale to consumers of electric energy within the limits of the City and County; and

Whereas, pursuant to resolutions of its Board of Supervisors looking to the acquisition of a municipally owned electric distribution system, the City has commenced and there is now pending before the Railroad Commission of the State of California, proceedings for the determination by the Commission of the compensation to be paid by the City for the local distribution systems and certain steam plants now owned and operated by the Pacific Gas and Electric Company and the Great Western Power Company of California, respectively, when the same shall be taken over by the City under eminent domain proceedings, or otherwise;

Whereas, the City has not funds available at the present time with which to purchase or con-

struct a distribution system of its own and it will be necessary to submit a proposition to the people to vote bonds to provide money for that purpose, before a distribution system can be purchased or constructed, and the City cannot well determine whether to purchase one or both of the local distribution systems, or to construct a distribution system of its own until the Railroad Commission determines the amount of compensation to be paid by the City for the taking of either or both of said local distribution systems under the proceedings now pending before the Commission; and

Whereas, the City intends to complete its power transmission line from Newark to San Francisco and to acquire or construct a distribution system of its own; and

Whereas, the said Moccasin Power Plant is now in condition to operate at its full capacity of 70,000 kilowatts and unless some temporary arrangement is made between the City and County for the distribution to consumers of the electric energy which can be purchased at said plant during the period that must elapse before the City can acquire, own and operate a distribution system of its own, there will be a great waste of said potential energy and a great loss of potential revenue to the City and its taxpayers; and

Whereas, the statistical and financial records kept by the City or the Company show the following, viz:

1. That the total capacity and possible annual output of energy from the Moccasin plant will not be sufficient to supply all municipal requirements and the demand of consumers in the City and County for electric power and energy, although in hours and days of low energy requirement the capacity and output may be more than sufficient to supply said requirements and demands during said hours and days.

2. That the average transmission and distribution losses of energy from the Newark substation of the Company to the various consumers' meters in San Francisco is 24 per cent of all energy delivered into the system of the Company at Newark for transmission and distribution to consumers in San Francisco.

3. That 2.383 cents is the average revenue per kilowatt hour received from all classes of consumers of the Company in San Francisco under existing rates based on the experience of the Company for the year 1924.

III. Now, Therefore, in consideration of the premises and the mutual covenants and conditions herein contained, the parties hereto mutually covenant and agree as follows:

First: The City hereby employs the Company and the Company accepts employment as temporary distributor for and on behalf of the City of the electric energy to be generated at Moccasin Power House and transmitted to Newark by the City over its own transmission lines. The City agrees to so maintain its Moccasin plant that it will, whenever necessary to do so, carry load up to its full capacity of 70,000 kilowatts, subject to limitations of its forebay storage and to accidents and unforeseen contingencies; and to deliver and consign the entire energy output of its said plant to the Company, save and except such portion thereof as may be reserved for City requirements as hereinafter provided. The Company agrees to accept such consignment of the entire energy output of Moccasin plant, less transmission losses and except such portion as the City shall retain as above and hereinafter mentioned delivered at not to exceed a 75 per cent monthly load factor, to make at its own expense the necessary physical connection of the City's transmission lines with its own system at Newark; to install all necessary equipment, facilities and proper meters for accurately measuring the amount of energy delivered; to transmit so much of said energy through its own system to San Francisco as may be required to light public streets and to meet other municipal needs for electric energy; to supply street railroads and other consumers of such energy in the City; to transform, convert, regulate, distribute and meter the energy sold; to furnish all necessary peak

load and steam standby service and collect from consumers of such energy the charges therefor, which shall not exceed the lawfully established rates, and make accounting to the City as hereinafter in Paragraph Fifth provided.

Second: The City agrees that the energy consigned to the Company from the Moccasin plant shall be the entire output thereof, diminished only by transmission and other losses and by such amounts as the City shall require for its own use in the construction or operation of any portion of the Hetch Hetchy project, and also by such amounts, if any, as the City may be legally required to furnish to irrigation districts or municipalities under the terms of the act of Congress, approved December 19, 1915, known as the Raker Act. Failure or inability of the Company to take at Newark a part of the energy which the City is in a position to deliver to it under the terms of this agreement shall not constitute grounds for deduction in the amount of the revenue to be paid to the City had such energy been received by the Company and sold to consumers, it being understood, however, that the Company is not required to accept the output of the Moccasin plant at a monthly load factor in excess of 75 per cent.

Third: In order to arrive at the amount which should be realized by it for its Moccasin energy consigned by the City to the Company at Newark under the terms of this agreement for transmission and delivery to consumers, the City has assumed (and the Company, for the purposes of this agreement merely, has acquiesced in the assumption) that of the energy consigned and delivered to the Company at Newark and by the Company delivered to consumers in the City and County of San Francisco there would be transmission, substation and distribution losses amounting to 24 per cent of the energy thus consigned and delivered at Newark and therefore 76 per cent of the energy consigned and delivered at Newark should be taken as the true measure of the amount possible of deliverance to consumers.

Fourth: In order to arrive at the amount which should be realized by it for its Moccasin energy consigned by the City to the Company at Newark under the terms of this agreement for transmission and delivery to consumers, the City has assumed (and the Company, for the purpose of this agreement merely, has acquiesced in the assumption) that inasmuch as in the year 1924 under existing rates the average revenue received by the Company from consumers in San Francisco amounted to 2.383 cents per kilowatt hour, such average revenue should be applied to 76 per cent of the energy to be consigned and delivered by the City to the Company at Newark for the purpose in this contract declared.

Fifth: In order to arrive at the amount which should be realized by it for its Moccasin energy consigned and delivered by the City to the Company at Newark under the terms of the agreement for transmission and delivery to consumers, the City has assumed (and the Company, for the purposes of this agreement merely, has acquiesced in the assumption) that the City shall receive for the energy consigned and delivered by it to the Company at Newark 26.935 per cent of 2.383 cents per kilowatt hour for 76 per cent of the energy so consigned and delivered at Newark, and that the Company shall receive 73.065 per cent thereof.

It is agreed by the City and the Company that the Company shall account for and pay over to the City for the energy so consigned and delivered to it by the City at Newark for transmission and distribution to consumers as provided in this contract 26.935 per cent of 2.383 cents per kilowatt hour for 76 per cent of the energy so consigned and delivered by the City to it at Newark, and the Company shall retain the aforementioned 73.065 per cent as its compensation for services rendered under this contract.

Sixth: The City shall not be obliged to deliver energy into the system of the Company at Newark, nor shall the Company be obligated to receive such energy at such time as either shall be prevented from doing so on account of accidents, acts of God or fire, making it physically impossible to so deliver or receive energy, or on account of strikes, riots, war, or any other cause beyond

reasonable power of control of either party. In the event of inability on the part of the City to deliver the said energy at Newark, or inability on the part of the Company to receive the energy at Newark, arising from any of the causes in this paragraph specified, the party so prevented from making such delivery of energy or receiving such energy shall proceed at all possible speed to take the necessary action to enable it to comply with its covenants herein contained.

Seventh: The net proceeds due the City, namely, 26.935 per cent of 2.383 cents per kilowatt hour for 76 per cent of the energy so consigned and delivered at Newark by it to the Company, shall be paid into the Treasury of the City and County of San Francisco by the Company in monthly installments and not later than the 15th day of each month after operation under this agreement commences. The amount of such payment shall be based upon the amount of energy actually delivered into the system of the Company at Newark during the preceding month. In the event of the refusal, failure or inability of the Company to take the available output of the Moccasin plant deliverable at Newark in accordance with the terms of this agreement, then the amount of energy which the City could have delivered shall be the basis of computing such monthly payment. The method for determining this amount shall be covered in the memorandum of technical specifications, details and conditions hereinafter provided for.

Eighth: Should the present established rates for the sale of electric energy in San Francisco be hereafter increased or decreased by lawful authority, then the amount to be retained by the Company and the amount to be paid to the City under the terms of this agreement shall be proportionately increased or decreased.

Ninth: Neither this contract nor anything contained herein, nor the prices, rates or charges fixed herein, shall ever be offered or in any manner used as evidence by either said City and County or said Company or any successor in interest of either of them in any court or before any commission or official of the State of California or the United States of America in any action or proceeding in which said City or any successor in interest shall be a party adversary to said Company, or any successor in interest, other than an action or proceeding between the parties hereto, or their respective successors in interest, or one of said parties and a successor in interest of the other, commenced and prosecuted for the purpose of obtaining a judicial or official interpretation or determination of the legality of this contract or of any provision thereof or for the purpose of enforcing its performance, or recovering damages for its nonperformance.

Tenth: It is expressly recognized that this contract is a temporary arrangement between the parties for distributing the energy output of the Moccasin plant over and through the Company's lines and system during the period that must elapse before the City can construct or acquire a distribution system of its own.

It is therefore agreed that the contract may be terminated at any time by either the City or the Company upon one day's previous notice in writing to the other.

Eleventh: It is further understood and agreed that this contract is subject to immediate cancellation upon request or demand of the Secretary of the Interior of the United States should he hold that in his opinion the agreement violates any provisions of the laws of the United States in general, or the Raker Act in particular.

Twelfth: All of the electric energy to be delivered and received pursuant to the provisions of this contract shall be three phase, 60 cycle, alternating current. The electro-motive force of such energy at the point of delivery shall be approximately 105,000 volts, slight variation in voltage and frequency to be permitted.

Thirteenth: The Company shall inspect, test and keep in proper repair all meters and accessories at Newark which will be used for measuring the amount of electric energy consigned to the Company under this contract. The said meters shall be kept under joint seals of the City and

Company which shall not be broken except in the presence of authorized representatives of both parties. Either party shall have the right at any time to request an inspection or test, and if found necessary, proper adjustment of such meters in the presence of a representative of the other party appointed for that purpose. When such inspection or test is desired, sufficient notice shall be given by the party desiring the test, to permit of the other party having its representative present. The registration of the meters shall be used as the basis of determining the amount of energy consumed hereunder, unless, upon being tested, the meters shall be found to register inaccurately and such inaccuracy shall exceed two per cent (2%). Where the inaccuracy is more than two per cent (2%), but the actual inaccuracy can be approximately determined, the readings of such meters shall be corrected and such corrected reading shall be used as a basis for determining the amount of energy delivered. Where the registry of the meters cannot be so properly corrected, the amount of energy delivered during such period of inaccurate registry shall be estimated by the engineers for the parties hereto from the average daily plant output of energy during such period, and from any other available and pertinent data.

Fourteenth: Technical specifications, details and conditions as to the construction of the interconnecting lines and switching apparatus at Newark, and as to the maintenance, repair and operation of the proper generating plant and transmission system of the City shall be agreed upon by the City Engineer of San Francisco and the Vice-President in charge of electrical construction and operations of the Company, and a memorandum of such agreed specifications and operating details shall be filed with and become part of this agreement; provided, that if any changes in said technical specifications or operating details may from time to time become necessary or advisable in the opinion of both of said parties, supplemental memoranda of the same shall be filed, and become part hereof without affecting the remaining terms of the agreement.

Fifteenth: The recitals hereinabove contained commencing with the words "Whereas, the City has not completed the construction of the Moccasin power plant", and ending with the words "a great loss of potential revenue to the City and its taxpayers; and" are statements made by the City of its purpose and intentions and concerning other matters contained in said recitals. Said recitals are not and no one of them is made by or on behalf of the Company. None of said recitals shall be binding on either of the parties to this agreement in any dispute, controversy or question which may ever hereafter arise in which the same might otherwise be relevant or pertinent.

In Witness Whereof, the Board of Public Works has caused these presents to be duly executed and signed by its members, and the Company has caused these presents to be executed by its officers first thereunto duly authorized by resolution of its Board of Directors, a copy of which is hereunto annexed, the day and year first above written.

BOARD OF PUBLIC WORKS OF THE
CITY AND COUNTY OF SAN FRANCISCO,

Attest:
S. V. HESTER,
Acting Secretary.

By T. A. REARDON,
By D. G. FRASER,
By C. E. STANTON,
Its Members.

(Seal)

PACIFIC GAS AND ELECTRIC COMPANY, A CORPORATION,

Attest:
D. A. FOOTE,
Secretary.

By F. A. LEACH,
First Vice-President and General Manager.

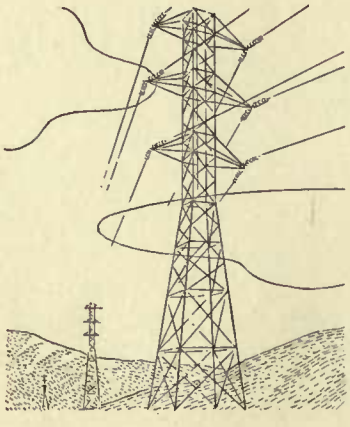
(Seal)

FINANCIAL RESULTS OF POWER DEVELOPMENT

To show that the plan of consigning the energy available at the Moccasin Power House to the Pacific Gas & Electric Company for delivery to the inhabitants of San Francisco was fundamentally sound, I am setting forth in the following table the City's annual receipts from sales to the Pacific Gas & Electric Company on account of this contract. These amounts have been calculated in accordance with the terms of the contract which interpreted into the average receipt for each kw.-hr. delivered is 4.878144 mills.

These receipts have covered the cost of operation, set aside $175,000 a year for depreciation, met the annual Government rental charge and in addition have paid bond interest on funds necessary to construct the power project and all parts of the water development utilized in power production. The surplus remaining has been utilized in the redemption of the bonds. The larger part of the bond interest and redemption incidental to the development of the water supply for the City of San Francisco has thus been carried by the power project. The people have had immediate benefit in that money which would otherwise have had to be raised through taxes has been produced by the present power policy. This direct benefit in some years has been in the form of a reduction of as much as twenty-one cents on the tax rate.

Even those most bitterly opposed to the plan of power consignment have not seen fit to cancel the contract with the Pacific Gas & Electric Company. Under the terms of the contract this may be done at any time through the Board of Supervisors issuing a one-day notice of cancellation.



HETCH HETCHY POWER DEVELOPMENT—REVENUES FROM SALE OF POWER

Fiscal Period	Early Intake *(Beginning 9/21/18)*	*Misc.*	Moccasin *(Beginning 8/15/25)* *P. G. & E. Co.*	*H. H. Constn.*	*Total*	*Combined Total*
1918-1919	$ 67,528.10	.....	.....	.....	.....	$ 67,528.10
1919-1920	68,338.72	.....	.....	.....	.....	68,338.72
1920-1921	72,263.60	.....	.....	.....	.....	72,263.60
1921-1922	23,186.56	.....	.....	.....	.....	23,186.56
1922-1923	38,912.39	.....	.....	.....	.....	38,912.39
1923-1924	50,267.22	.....	.....	.....	.....	50,267.22
1924-1925	57,644.87	.....	.....	.....	.....	57,644.87
1925-1926	59,244.08	$ 814.25	$ 1,993,965.49	.....	$ 1,994,779.74	2,054,023.82
1926-1927	42,405.00	311.01	2,294,280.85	.....	2,294,591.86	2,336,996.86
1927-1928	65,570.52	310.20	2,321,149.68	.....	2,321,459.88	2,387,030.40
1928-1929	23,072.65	290.73	1,960,533.87	$ 21,765.54	1,982,590.14	2,005,662.79
1929-1930	39,489.86	138.66	2,070,996.51	76,447.83	2,147,583.00	2,187,072.86
1930-1931	32,473.15	144.73	1,951,921.01	140,624.95	2,092,690.69	2,125,163.84
1931-1932	49,325.57	458.57	1,411,988.53	162,772.19	1,575,219.29	1,624,544.86
1932-1933	44,804.16	320.61	2,001,615.64	125,258.08	2,127,194.33	2,171,998.49
1933-1934	41,145.84	217.18	2,189,314.58	66,996.67	2,256,528.43	2,297,674.27
Totals to June 30, 1934	$775,672.29	$3,005.94	$18,195,766.16	$593,865.26	$18,792,637.36	$19,568,309.65

Receipts deposited in 1910 Water Construction Fund, Hetch Hetchy Operative Revenue Fund, and Hetch Hetchy Power Operative Fund.

The above tabulation does not include the value of power consumed on Hetch Hetchy construction during the period from July 1, 1918, to October 31, 1928. This power may be valued at approximately $700,000.00.

CHAPTER XIII

Financial Aspects of the Hetch Hetchy Project

ON March 25, 1916, I submitted a preliminary report on San Francisco's project for developing a water supply, in which I emphasized the obligations created by the expansion of the project from a 60 million gallon a day utility as the original project was conceived, to the 400 million gallon a day project outlined by Mr. Freeman and approved by the City authorities and constructed by me, permit for which was approved by Congress in its so-called Raker Act. This expansion in capacity necessarily meant an increase of the cost of the project originally estimated. The prices for labor and materials, due to war activities, since 1910 have also materially increased the cost.

In the indicated plan of 1916 I stated:

> Hetch Hetchy will be the first reservoir site utilized. The large Lake Eleanor and Cherry Valley dams will be built later, as the necessity for increasing the water supply beyond the capacity of the Hetch Hetchy watershed arises. The aqueduct in the initial development will consist of 67½ miles of pipe 5 to 5½ feet in diameter, 66 miles of tunnels 10½ feet in diameter, a total length of 133½ miles to the Crystal Springs Reservoir in San Mateo County. After the first 19 miles of aqueduct from Early Intake to Priest is completed the water will be dropped vertically 1300 feet to the electric generating station at Moccasin Creek, where an average of 100,000 h. p. will be available. An ultimate consumption in the San Francisco Bay region of 400 million gallons daily from this source is now contemplated, and the aqueduct tunnel above the power house and to the San Joaquin Valley is designed for this quantity, so that the full amount of water may be diverted and used in the power house at once, thereby safeguarding the City's water rights and *giving the City a marketable asset at an early stage of development.*

The Freeman plan also called for all tunnels to be built at once for 400 M. G. D. capacity, the San Joaquin Valley pipe line for 240 M. G. D., and the pipe line from Irvington to San Francisco for 50 M. G. D. to 100 M. G. D.

In the interests of economy and due to the restrictions of utilization of irrigation waters in the Raker Bill, the size of parts of the initial pipe installation recommended by Mr. Freeman has been modified. The tunnels on the steep mountain grades, 36 miles long, on the easterly edge of the San Joaquin Valley have been completed for 450 M. G. D. capacity. The grades in the mountain division are steep, so that this extra tunnel capacity did not involve very much extra outlay. The two tunnels in the Coast Range Division are constructed on a flatter gradient, about 2½ feet fall to the mile, due to keeping the delivery head 290 feet at the higher level proposed in Crystal Springs, and will each have a capacity of 300 M. G. D. Provision is made when carrying capacity is reached for duplicating the first Coast Range Tunnel, 28.51 miles long, by completing a similar sized one 175 feet distant southerly on the acquired right of way, when the population and increased demand for water in San Francisco warrants this additional supply. The shafts and hoisting apparatus on this 28.51-mile route have been centrally

located so as to provide facilities for economically constructing the future southerly tunnel.

FINANCIAL SHOWING

During the early period from 1900 to 1906 there was expended on preliminary investigations	$ 44,000
During the period from 1906 to 1910	74,000
During the period from 1910-11, including $537,000 for lands and water rights, there was expended	603,000
During the period from 1912 to January 31, 1916, including lands and water rights, and rights of way, of $697,000, there was expended	1,546,000
Which means a total expenditure for preliminaries from 1900 to 1916 of	$2,267,000

On February 4, 1916, Exhibit "I" illustrates the conditions of appropriations:

EXHIBIT "I"

CONDITION OF HETCH HETCHY APPROPRIATIONS

February 4, 1916

Closed Accounts	*Amount Appropriated*	*Expended*	*Balance*
City Engineer's part salary	$ 5,000.00	$ 5,000.00	.....
Cooperative road work	3,500.00	3,500.00	.....
Hog Ranch road to Hetch Hetchy damsite	180,943.84	180,943.84	.....
Hydrographic data for Government	5,000.00	4,999.70	$ .30
Investigating sources of water supply, B. P. W.	140,651.29	140,408.29	243.00
Lake Eleanor	45,000.00	25,476.32	19,523.68
Investigating McCloud River project	500.00	500.00	.....
Priest's Hill, construction of roads	2,500.00	2,500.00	.....
Engineer's appraisal of Spring Valley water system	3,500.00	3,500.00	.....
Investigating claims of Spring Valley Water Company in Alameda County	1,400.00	1,400.00	.....
Boring test holes in Richmond and Sunset Districts	5,137.01	5,137.01	.....
Investigating Turlock and Modesto Irrigation District	500.00	318.90	181.10
Open Accounts			
City Engineer's investigation of Hetch Hetchy	2,000.00	2,000.00	.....
Clearing Hetch Hetchy reservoir	43,000.00	17,032.21	25,967.79
Diversion tunnel and diversion dam at Hetch Hetchy	90,500.00	51,061.50	39,438.50
Purchase of gaging apparatus and instruments	5,000.00	1,715.58	3,284.42
General office work, plans, etc.	31,000.00	23,566.58	7,433.42
Hydrography, by B. P. W.	13,000.00	11,031.01	1,968.99
Installing sawmill	13,000.00	12,992.20	7.80
Inspection and engineering in field	8,000.00	6,369.81	1,630.19
Inspection of track material for Hetch Hetchy Railroad	900.00	.....	900.00
Insurance with State Compensation Fund	1,000.00	228.90	771.10

Open Accounts	*Amount Appropriated*	*Expended*	*Balance*
Operating sawmill	14,000.00	12,912.01	1,087.99
Permanent camps and equipment	18,500.00	16,284.92	2,215.08
Roads, trails and surveys	72,250.00	71,665.14	584.86
Surveys, aqueduct location	9,500.00	7,188.92	2,311.08
Surveys, railroad location	8,000.00	7,932.23	67.77
Telephone lines, Hamilton to Hog Ranch or Portulaca, etc.	5,000.00	4,987.56	12.44
Test borings	5,000.00	.....	5,000.00
Timber cut on Government lands	1,000.00	452.81	547.19
Water rights and protective work	20,000.00	13,702.93	6,297.07
Drilling wells on City property in Richmond and Sunset Districts	15,997.05	14,534.43	1,462.62
TOTALS	$770,279.19	$649,342.80	$120,936.39

The foregoing are the various accounts of the 1910 Water Construction Bond Fund, showing the amounts appropriated and expended out of same by the City Engineer up to February 4, 1916, as taken from the accounts of the City Auditor.

EXHIBIT "J"

APPROPRIATIONS REQUESTED FOR HETCH HETCHY WATER SUPPLY, WORK TO BE EXECUTED FROM MARCH TO DECEMBER, 1916

1.	Hydrography	$ 12,000
2.	Surveys, aqueduct, San Joaquin Valley, etc.	15,000
3.	Water rights and protective work	30,000
4.	Test borings on aqueduct line (additional to $5,000 already appropriated but not yet used)	20,000
5.	Headquarters engineering, including consulting engineers, geological studies and general office expense	75,000
6.	Roads and trails	20,000
7.	Inspection and engineering in field	35,000
8.	Permanent camps and equipment	24,000
9.	Operation of sawmill, 1916	10,000
10.	Diversion tunnel and diversion dam	23,000
11.	Foundation work for main Hetch Hetchy dam	52,000
12.	Railroad equipment and buildings	50,000
13.	Lower Cherry power development for construction purposes	100,000
14.	Acquisition of necessary rights of way through privately owned lands	500,000
	TOTAL	$966,000

Appropriations for the construction of the Hetch Hetchy Railroad and the clearing of the Hetch Hetchy reservoir site have already been made.

CHRONOLOGICAL DATA IN CONNECTION WITH THE SALE OF 1910 WATER BONDS FOR MAIN HETCH HETCHY AQUEDUCT

January 29, 1917—In annual report on Hetch Hetchy project, submitted to the Mayor, the Board of Public Works, and the Board of Supervisors, the City Engineer recommended the sale of $11,000,000 of bonds for the prosecution of the work during the year 1917. Of this amount, it was estimated that $6,000,000 would be required for the Hetch Hetchy Aqueduct.

February 19, 1917—Resolution was presented by Supervisor Power, directing Clerk to advertise for proposals for the purchase of $1,640,000 bonds. Proposals to be received March 19, 1917. Laid over one week on motion of Power.

February 26, 1917—Above resolution, laid over from meeting of February 19th, taken up and on motion was laid over until next meeting (February 27, 1917).

February 27, 1917—Above resolution, laid over from meeting of yesterday, February 26th, taken up and on motion was laid over for one week.

March 5, 1917—Above resolution, laid over from last meeting, February 27th, taken up and referred to the Finance Committee.

March 26, 1917—Resolution No. 14151 (by Power) adopted, directing Clerk to advertise for proposals, to be received April 16, 1917, for purchase of $11,090,000 bonds.

April 16, 1917—Bids received for purchase of $11,090,000 bonds. Only one bid received, that of Anglo & London Paris National Bank, who bid $1,641,148 for $1,640,000 par value bonds, to be taken immediately. This bid was contingent on their being given an option on $5,000,000 par value, and $4,450,000 par value, bonds in addition to the $1,640,000. This option was to extend to July 1, 1917, on the $5,000,000 and to October 1, 1917, on the $4,450,000 and notice of 30 days was to be given to the City as to bank's intention to take up options at times stated.

April 23, 1917—Resolution No. 14252 (by Power), accepting bid of Anglo & London Paris National Bank for $1,640,000 bonds, par value, for $1,641,148 and accrued interest, subject to the options stated in the bid. The Treasurer was directed to place the amount of bonds represented by the options, namely, $9,450,000, on sale, for delivery to the bank if the options were exercised.

May 28, 1917—Resolution No. 14417 (by Power), granting to the Anglo & London Paris National Bank an extension to August 1, 1917, in which to exercise their option on the purchase of $5,000,000 bonds. This extension of time carried with it a corresponding extension of the time within which notice of exercising or rejecting option must be given.

July 30, 1917—Communication from the Anglo & London Paris National Bank, signed by J. W. Lilienthal, Jr., Assistant Cashier, addressed to Mr. John S. Dunnigan, Clerk of the Board of Supervisors, notifying him that the bank had decided not to exercise its option No. 1. The reason given for their failure to exercise this option was the present unfavorable condition of the bond market and their inability to market 4½% bonds.

August 22, 1917—Bids were received for the construction of the tunnel aqueduct in the Mountain Division of the Hetch Hetchy project. Three bids were submitted. Tabulations thereof are attached thereto. City Engineer recommended the rejection of all bids on the basis that the figures quoted were excessive.

January 5, 1920—No offers.

November 2, 1920—Bond election changing rate of interest on bonds not to exceed 5½% from 4½%. Yes, 74,652; No, 45,970.

August 1, 1921—$13,250,000 sold on 5.49% basis to Con. Co. of No. America. Sold on 5.40% basis. Option to November 1, 1921, on $8,350,000 option to purchase. October 24, 1921, option extended to February 25, 1922.

The following is a resume from the City Auditor of the entire disposal of bonds to date by the City of San Francisco, indicating the premiums and the discounts on same:

		Bonds Sold	*Premium*	*Discount*
June	1909	$ 600,000.00	$ 3,050.00	.....
May-Dec.	1911	977,000.00	.....	.....
Jan.	1912	148,000.00	.....	.....
Feb.-Dec.	1914	462,000.00	.....	.....
Jan.-Dec.	1915	442,000.00	.....	.....
	1916	2,156,000.00	200.00	.....
	1917	1,640,000.00	.....	.....
	1918	1,399,000.00	.....	.....
	1919	6,093,000.00	.....	.....
	1920	4,576,000.00	.....	.....
	1921	21,826,000.00	10,000.00	$2,898,536.55
	1924	5,281,000.00	.....	81,790.00
		$45,600,000.00	$ 13,250.00	$2,980,326.55
				13,250.00
				$2,967,076.55
	1925	$ 1,000,000.00	$107,211.00	.....
	1926	2,000,000.00	130,490.00	.....
	1927	4,400,000.00	337,217.47	.....
	1928	2,600,000.00	292,529.00	.....
		$10,000,000.00	$867,447.47	
1928 Bond Issue $24,000,000.00				
	1928	$ 8,000,000.00	$ 71,600.00	

The most noticeable item of discount in the history of the sale of Hetch Hetchy bonds occurred on August 1, 1921, when, due to changing rate of interest from 4½ per cent to 5½ per cent, a discount of $2,898,536.55 was obtained by a group of bond buyers in a purchase of $21,826,000, and this necessarily reduced the amount of money available for construction work on the Hetch Hetchy Project. This group included the following bond buyers of San Francisco:

National City Co.
Anglo & London Paris National Bank
E. H. Rollins & Co.
Blyth, Witter & Co.
Bank of Italy
Cyrus Pierce & Co.
R. H. Moulton & Co.
Mercantile Trust Co.
Carstens & Earles
Kissel, Kinnicut & Co.
Stacy, Braun & Co.
Eldreth & Co.
Bankers Trust Co.
First National Bank of New York

When the Panama Canal was built—1905-1914—by the United States Government, United States bonds were readily sold on as low as a 2 per cent basis. When the United States entered the European war in 1917 money conditions tightened and the price of Government money advanced from the previous low price of 2 per cent, up to 4½ and 5 per cent. This period of war activity straddled the Hetch Hetchy construction and bond sale period, and hence an amendment to the Charter to further the sale of bonds by increasing the interest rate was voted by the people on November 2, 1920, changing the permissible rate of interest from 4½ to 5½ per cent. This matter was explained at that time to the people of San Francisco and approval for this change was given by the vote and with the full knowledge of the public to increase the rate of interest on the bonds, which was a perfectly justifiable measure.

Referring afterwards to critics of this policy, the Finance Committee, consisting of Supervisors McLeran, Rossi and McGregor, reported as follows:

> The Finance Committee desires to inform the Board and the public that Supervisor McSheehy is constantly reiterating misstatements and innuendos in reference to this financial transaction. His conduct is unbecoming a public official who voted affirmatively on every occasion when the matter was acted upon by the Board.
>
> The facts demonstrate that his statements are unwarranted and ridiculous. He is careful not to charge any irregularities. He knows better than to do that, and after a year and a half, he is attempting, under the pretenses of seeking knowledge, to convey by innuendo to the public that honorable and reputable officials have been derelict in their duty. He knows that all the facts are public records available to anyone at any time. And these facts and records show that his queries and statements are not made in good faith, but are, in our opinion, inspired by SELFISH AND UNWORTHY MOTIVES.

The total amount of bonds sold for the so-called Hetch Hetchy Project on different dates has been as follows:

1909	$ 600,000
1910	45,000,000
1925	10,000,000
1928	8,000,000
	$63,600,000
Discount approximately	3,000,000
Net cash available	$60,600,000

There is still in the Treasury unsold, June, 1930, $16,000,000 of 4½ per cent bonds, which is appropriated to cover the completion of the Coast Range Tunnels and of the pipe line across the San Joaquin Valley.

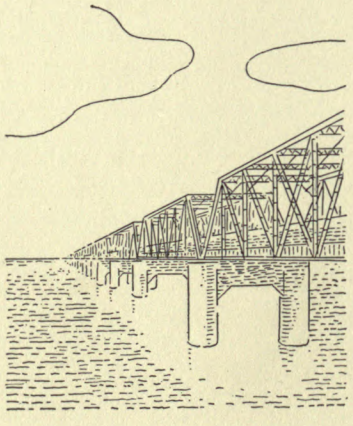
FINAL BOND DISPOSAL

	Vote			*Bonds Outstanding*
	For	*Against*	*Bonds Authorized*	*June 30, 1933*
1909	34,572	5,641	$ 600,000	None
1910	32,888	1,609	45,000,000	$32,000,000
1925	68,549	3,361	10,000,000	9,000,000
1928	94,859	11,331	24,000,000	24,000,000
1932	128,691	9,373	6,500,000	5,477,000
			$86,100,000	$70,477,000

After further expenditure in completing the Coast Range Tunnels, the financial picture as of July 1, 1934, may be stated as follows:

Coin expended by the City	$75,000,000.00
Interest paid by taxpayers	10,500,000.00
	$85,500,000.00
Dividends to date—sale of power	19,568,309.65
Net cost of project to taxpayers	$65,931,690.35

This is a large outlay for a small city, but considering the Ashokan Water System of New York, a much shorter distance—120 miles—cost $185,000,000—the engineers and builders of San Francisco are entitled to due credit.



CHAPTER XIV

Acting Mayor McLeran's Attack Fiasco

ON November 24, 1924, the Board of Public Works and City Engineer were served with the following notice from the Acting Mayor, Ralph McLeran, then Chairman of the Finance Committee of the Board of Supervisors:

MAYOR'S OFFICE
SAN FRANCISCO

San Francisco, Cal., November 24, 1924.

To the Honorable Board of Public Works,
City Hall,
San Francisco, Calif.

Gentlemen:

On November 13, 1924, the Finance Committee of the Honorable Board of Supervisors was unexpectedly informed by the City Auditor that the Hetch Hetchy construction fund, created by the 1910 bond issue, was at the point of exhaustion, but $8,136 remaining in the treasury with which to meet all obligations other than those provided for by certain contracts for which the money had actually been set aside.

No notification that such an amazing condition was in prospect had previously been received. The City Auditor declared himself unable to meet accruing demands and obligations arising from Hetch Hetchy construction work.

Immediate investigation of this unprecedented situation resulted in a request by the Finance Committee upon the City Engineer for a complete statement of Hetch Hetchy finances, the City Engineer having been entrusted for several years past with the entire responsibility of the Hetch Hetchy project, both in its engineering and financial aspects.

This statement, rendered on November 21, 1924, and amplified by statements made under questioning by the Finance Committee by the Assistant City Engineer, showed that the sum of $1,839,000 is still needed to complete the Mountain and the Bay Crossing divisions of the said project and the electrical transmission line, for the covering of which sum no money remains in the 1910 bond fund.

Disregarding this lack of money, the City Engineer was disclosed as continuing to incur obligations against the City and County nonetheless, so that an actual deficit of $332,567.33 exists as of the present date and is increasing daily.

It was further developed:

That practically every item of construction work is greatly exceeding, in actual cost, the estimates made within the last few months by the City Engineer's office and formally reported by that office to the Board of Supervisors.

That neither your Honorable Board of Public Works, nor the City Engineer or his staff, had at any time warned the Honorable Board of Supervisors of the approaching shortage of funds that would arise from these excess expenditures, and that if timely warning had been given, the Board of Supervisors as a matter of course could have made proper provision for avoiding the unbusiness-like situation created by the deficit.

The Honorable Board of Supervisors will of course feel it obligatory and incumbent upon it

to liquidate the unpaid claims already existing, amounting to the November payroll of approximately $180,000 and additional bills for supplies and materials.

But to prevent all possibility of a repetition of this unwarranted and dangerous course, whereby obligations are incurred without funds being on hand to pay for the same, I find myself compelled to issue the following instructions, by which you are to be governed from this present date:

That all construction work upon the Hetch Hetchy project shall cease upon November 26, 1924, excepting as follows:

First: The Bay Crossing Division of Hetch Hetchy between Calaveras Dam and Crystal Springs shall be pushed to completion with all possible speed in order to insure an adequate water supply for San Francisco from the Calaveras reservoir.

Second: The electric towers for the transmission line, already purchased and on the ground, shall be erected from Moccasin Creek power house to Newark.

Third: The transmission line, already purchased and on hand, shall be installed from Moccasin Creek power house to Newark.

Fourth: The Moccasin Creek power plant shall be completed, and the machinery already purchased and on the ground shall be installed.

Fifth: Those several items of construction work covered by various contracts, for which moneys have already been allocated and set aside from the 1910 bond fund, and are at present in the treasury, shall be continued; but only within the limits of the bond money actually on hand and set aside for each particular contract.

You are hereby directed to forthwith lay off all the field and office force not actually engaged in carrying out the above specifically mentioned items of work. This shall apply equally to the San Francisco office as to the men in the field.

You are instructed to provide a sufficient number of watchmen to safeguard the City's property where there is a cessation of work by reason of these instructions.

You are instructed that no resumption of any item of discontinued work shall be undertaken until notification is received from the Board of Supervisors that funds are in hand.

You are further instructed not to incur expense of any nature concerning the work to be done under the 1924 bond issue, until such time as the Honorable Board of Supervisors authorizes the sale of said bonds, and money is provided for such indebtedness.

Please keep this office advised of all progress made in the carrying out of the above instructions.

Respectfully,

(Sgd) RALPH MCLERAN,
Acting Mayor.

The real elected Mayor, James Rolph, Jr., was in Boston for a month attending the convalescence of his sick son in a Boston hospital. The acting and temporary Mayor McLeran, taking advantage of his absence, assumed grave responsibility in attempting to enforce this order and on my behest a private citizen of San Francisco, John H. Robertson, sought a court injunction and retained a distinguished member of the bar, John F. English, an ex-Assistant City Attorney, to restrain McLeran and the Board of Public Works from executing this pernicious order. For this purpose he procured a restraining order.

Several previous circumstances led up to the depletion of the City's Hetch Hetchy funds. In an address of explanation I made before the Board of Supervisors on November 24, 1924, I stated in reference to the improper accounting system of the Finance

Committee quotations from a letter addressed by me to the Honorable Board of Public Works on September 28, 1923:

ADDRESS OF
CITY ENGINEER M. M. O'SHAUGHNESSY

MONDAY, NOVEMBER 24, 1924,
BEFORE BOARD OF SUPERVISORS OF SAN FRANCISCO

CHIEF ENGINEER O'SHAUGHNESSY: Madam Chairman, and gentlemen of the Board: About six weeks ago I discovered that we were running very close on our mountain expenditures. A year and a half ago, from all the accounts and balances and statements we had, I figured we would have at least a million dollars to spare after doing all the mountain work, from Early Intake, down to Priest Reservoir, including the tunnel lines, the power house and the transmission lines as far as Newark. On October 9th, after I discovered a shortage in funds, I made a date with Supervisor McLeran, the Chairman of the Finance Committee, to come down with me and see this portion of the work at Dumbarton, so he would get some idea of the work on the ground. To my knowledge he has not been over the Hetch Hetchy project since 1919, in June, when we were considering the construction of Hetch Hetchy Dam, and I wanted him to see the work. He could not go on the 9th, but on the 16th of October, we went down to Dumbarton and went out on this bridge at the Bay Crossing, 3800 feet long. The piers are 107 feet 6 inches, center to center, all concrete, resting on piles, first-class construction. All of the 36 piers were poured except the terminal pier at the end, which is 74 feet in diameter. It is the largest unit of construction in the project and the most difficult. That one bridge alone has five times the difficulties of construction compared to this little subway fronting the Ferry Building. So that gives you an idea of the magnitude of that work. I never said a word to Mr. McLeran to influence his mind on it. I simply pointed it out to him. He is a practical construction man; he has done a great deal of construction work, and lately some heavy construction work, and he is the man on this Board most familiar with construction work. I pointed out that we were, first, going to use wooden trestle like the piling of the Southern Pacific. That was the construction on which was based my first estimate. But after I came to investigate, I found out that there was a great deal of depreciation in those piles from sea water and teredos and the Southern Pacific Company has forces constantly renewing them. And so I did not deem it a wise method of construction for the City, and so therefore resolved on this heavier concrete pier construction of concrete resting on piles.

On the 15th of last December (1923), we invited the Public Utilities Committee of this Board, including Supervisors Shannon, Schmitz, McSheehy, Miss Morgan, and Mulvihill, to go and see the work on the ground and approve of the revision of plan. And, eventually, we had meetings here in the hall of the Public Utilities Committee and the Finance Committee combined, when the question of a change of plans was considered, and obtained the practically unanimous vote of that committee to approve my change of plans.

Now, that took over $600,000 out of our fund, and I said to Mr. McLeran in a friendly way, on October 16th, 1924, I said, "Mac, I want to get $600,000 out of our earnings fund, to make up for this deficit to continue work in the mountains," and he said, "You will have it." And here is a memorandum written on that same day, the 16th of October, 1924, after I left him at his office in the Examiner Building at half past 12, after I reached the Engineer's office returning from Dumbarton, a note for Mr. Eckart, my Chief Assistant, showing "McLeran O. K. for $600,000. Ring up Advisory Committee and Utilities Committee for East Bay Meeting, 10 A. M. Friday." Here is the letter resulting from that, with regard to this East Bay Committee, and the notice to the committee. We subsequently had the meeting. I had no idea until a week ago last Friday, the

14th of November, that he had changed his mind as to that promised appropriation, or that he had any other understanding of that situation, and I believed that $600,000 will finish the mountain end of the project down to our power house. As things stand now the dam at Early Intake is finished, excepting the little intake chamber about the size of this room here to admit water to enter the tunnel, and we have made estimates of those remaining units to finish this conduit down to Priest, and on the sheet given you by Mr. Eckart last Friday, you will find those balances on page 8.

The first four pages are introductory with my signature. Starting with the next five, six, seven, eight. And here, under the heading, "Hetch Hetchy water supply expenditures incurred and to be incurred from the bond issue of 1910, as of November 1, 1924." And in the middle of the column of that page 8, you will see the different items that are needed to be expended.

The men are now scattered for twenty miles over the project doing this work, and are working very efficiently, and it is absolutely necessary that this work be done now because, if the floods come and submerge the intake of our dam in the winter, all the sand and gravel above will be destroyed and it will be very difficult to get that intake installed.

Now, the other sheets cover other phases of the project. Here is another document with sheets number 1, 2, 3, 4, 5, and 6, which show every contract let on the Hetch Hetchy project, from number 1 to number 105, with all the conditions relating to these contracts. And at the end is the total, the total amount of contracts let on this project which have amounted to $25,139,000 of work done by contracts. Now you must bear in mind that every contract was awarded on my recommendation by the Board of Public Works after clean-cut bidding, and appropriations were made by the Board of Supervisors. Now, if you take the total sum of $45,000,000 which we have had for this project, you will find that $3,000,000 of all the money went into the purchasing of land; $3,000,000 went into discount on our bonds when we changed our rate of interest from 4½ to 5½ per cent. The bankers bought our bonds at a depreciated value, and that is the only way we could get money, by changing the rate from 4½ to 5½ per cent. We had good precedent for that, because the United States Government in building the Panama Canal in 1904 issued salable bonds at 2 per cent, and finally, we came along to war times, and the United States changed the rate to 5 and 6 per cent, and the last Government notes in the war period were 6 per cent notes. So we had good precedent for changing this rate of interest from 4½ per cent to 5½ per cent to get money for this project, because if we did not get that money work would have been stopped and we would have risked the loss of our water rights on the main Tuolumne River.

Resulting from that last visit of Mr. McLeran and Mayor Rolph, in July, 1919, to the Hetch Hetchy project, when I had plans prepared for the dam, and told them it was necessary to let a contract for that dam, to have the work done, to have our water impounded for the people of San Francisco, to give us the priority rights on flood waters in the river. And due to the fact that we had all preparations made, with plans and specifications ready to do that work, we got two very favorable bids, and that dam was commenced in 1919 and finished in April, 1923, two months ahead of the time that the Don Pedro Dam, of the Turlock and Modesto Irrigation Districts, was built, and that priority in the completion of our dam gives us the priority rights to flood waters on the Tuolumne River. If the irrigationists' dam had been finished first, they would have had the first right, and they need not have come to us and asked us subsequently for water this year, they could have gone and opened our gates and released our water.

With that dam construction proposition to one side, we had to undertake the work on the tunnels, and this contract has been let to a local concern, the Construction Company of North America, and the tunnel is all done, the concrete is all on the sides and the roofs of the tunnels, and the only thing remaining to be done now is to pour the inverts on a length of 36,000 feet of the tunnel bottom. And we have two crews engaged in doing that work, and they are making about a thousand lineal feet a day, or a mile in ten days, or three miles a month. And my program was to have that invert work done the first of February.

Now, to take up this system of accounts again presented by Mr. Eckart. I think every member has a copy of that document. Has every member a copy of this financial report?

SUPERVISOR MCLERAN: We all have.

CHIEF O'SHAUGHNESSY: Now, if you come down to "relative costs."

SUPERVISOR WELCH: What page?

CHIEF O'SHAUGHNESSY: Page 12; 15 is the last, then 14, 13, 12. Now, I have here the item of engineering cost. I see by statements quoted in newspapers by Mr. McLeran last week that we are accused of having too much overhead expense in our engineering, that we have not worked with economy, and I want to rebut that statement. The entire cost of all our engineering expenses is $1,244,000, about, the top item. If you will take $35,000,000 for the amount of money expended, you will find that our engineering costs are less than 4½ per cent. I want to compare that with the New York water supply system, where the engineering costs on $180,000,000 was $18,000,000, or 10 per cent. In other words, our engineering costs for our great San Francisco project are less than half, or 5½ per cent less than those of New York. The same thing may be said about the costs of our land department.

But, before I leave the Engineering Department, I want to pay a tribute to Mr. Nelson Eckart, my principal Assistant Engineer on this project, under whose administration all the Municipal Railways were built in San Francisco.

Coming now to our land business, under charge of Mr. Searls and Mr. Joseph Phillips. The lands and rights-of-way amount to practically $1,400,000 and our costs of acquiring these lands is 6.52 per cent. The costs on the New York project, with an elaborate system of rights-of-way, including all those odd pieces and odd rights-of-way, and excluding engineering, are 11.1 per cent. Our cost is less than half that of New York.

Now, we will go to our large proposition or the Hetch Hetchy Dam, which your Board did me the very great honor of christening in my name. That dam was started in August, 1919, and it was finished in April, 1923.

The city of New York is building the dam at Gilboa, with a foundation depth of 40 feet, and they are not going to get finished with that dam for another year and a half, with many less difficulties and with about the same cost; their contract was awarded in June, 1919. Our difficulties were much greater, our depth to bottom of foundation 70 feet more, yet we got our dam finished three years ahead on time schedule.

I have, in my folder here, a book on this new Los Angeles County water supply system comprising a system of 10 reservoirs in the surrounding hills, and the estimates there for one dam at San Gabriel that will not hold very much more water than the Hetch Hetchy Dam are $25,000,000. And the city of Los Angeles voted $35,000,000 last April to build those dams, and they are now under process of construction, and one dam alone there, less in size than Hetch Hetchy, is going to cost $25,000,000.

Take the Los Angeles Aqueduct. During this last year we heard an awful lot of blowing about its capacity and what it has done for Los Angeles. It is really the spinal cord of Los Angeles. Without that aqueduct they were gone for a water supply this year, and property there would have been of no value. That aqueduct carried this year 100 second feet of water, one-fourth the capacity it was built for, for the reason that they have built no head-works or no dams above their intakes to hold the flood waters. And the only way they fill it is by having a series of wells sucking the briny water out of the plains by means of pumps to aid their supply. You have heard what happened last week to that policy, by the people of Owens Valley, who severed the aqueduct by powder explosions due to agitation by adverse feeling.

Now, San Francisco has adopted a different policy. We have gone ahead and we have built this

large dam in the mountains to safeguard our future and to demonstrate our intentions, and it is very much of a success. This past year we were able to release over 110,000 acre feet of water to the farmers of Turlock and Modesto for $1.50 per acre foot, or less than half a cent per thousand gallons, and they were very grateful for our cooperation.

Now, coming down to estimates and to a history of our work, there are only two members of this Board here now—Supervisor Hayden and Supervisor McLeran—who were on this Board when I took charge of the Engineering Department, the 1st of September, 1912. We had then under way the construction of the Stockton Street tunnel, designed by my predecessor. It was intended to be constructed by an assessment district, cost to amount to $650,000. The tunnel is 900 feet long and the arch is 50 feet wide, and the plans previously made called for 18 inches concrete thickness on top of arch. There was quite a row over it. The brick men said you could not build an arch of concrete—it would have to be made of brick. So that got me to investigating, and I found out it would be necessary to thicken that arch and the abutments. I think ex-Supervisor Gallagher was chairman of the Tunnel Committee at that time, and I told him about it, and told him that it would be necessary to thicken this arch, and increase the cost, and the estimate went up $65,000 more, or 10 per cent on the computed cost of the project, and everyone was happy.

Now, if you take the Twin Peaks Tunnel, designed by myself, there is a direct contract cost of $3,400,000, made on the Engineer's estimate. The excess over estimates on that whole contract was about $120,000, or less than 3½ per cent.

Now, Mr. McLeran told me that same day that we went down there to Dumbarton Bridge, that the estimate for this beautiful War Memorial Museum built by him out here in Lincoln Park was $750,000, the original estimate, but that there were so many changes made on it that it ended up at about a million and a half—an increase of cost of 100 per cent. He is not to blame for that. The architect and the owners made those changes. But I want to say that our estimates have been always very consistent. There has never been made an estimate to deceive the members of this Board or to suppress the facts from them. We have nothing to be ashamed of, we have much to be proud of as citizens and officers of San Francisco, in the manner in which we have handled this project. No one may be censured with justice if war costs have increased initial estimates 70 per cent.

Now, I just saw a statement that was handed to me by one of the press gentlemen at 1:30 P. M., where Mr. McLeran, as acting Mayor, has issued an order as acting Mayor to the Board of Public Works, dated November 24, 1924, ordering us to stop all work, all the small amount of work that needs to be finished from the intake to the power house, a distance of 19 miles, and proceed with the building of the power house and the finishing of the transmission line, 100 miles west to Newark; in other words, placing the cart before the horse by building the transmission line ahead of the hydraulic end. I do not think that that is a wise recommendation. He is Mayor of this City, and it is the duty of the members of the Board of Public Works and the City Engineer, if the Mayor issues a legal order, it is our duty to obey it, and work will be stopped exactly as he says, in accordance with this order, but I want to tell you right here and now, that the execution of his order is going to be a serious menace and an expense to the ratepayers and the taxpayers of San Francisco.

Now, with regard to this change of ordinance. I have here a written document made in reply to it, and will kindly ask Mr. Dunnigan, if he is here, if he will read it.

(Chief Assistant Clerk Rogers reads the statement of Chief O'Shaughnessy):

"Honorable Board of Supervisors,
City and County of San Francisco, City Hall.

"November 24, 1924.

"Gentlemen: At the meeting of your Finance Committee held Friday, November 21, 1924, the Committee announced its intention to recommend the repeal of the enabling ordinance passed

by your Board of Supervisors, under which the Board of Public Works is authorized to enter into contracts, hire men and purchase materials and supplies for the construction of the Hetch Hetchy project. This action, according to the statements made at the time by the Committee, is actuated by the fact that certain estimates of work which I have heretofore made have been exceeded in actually constructing the work, and is intended as a curtailment of all authority to proceed further with the project.

"It is not my purpose in this communication to defend my estimates or reasonableness of the cost of work on the Hetch Hetchy project. The work speaks for itself. My files are full of voluntary testimonials from engineers of national repute and other construction experts who have visited the work, as to the evident efficiency with which it is being conducted. Your Committee does not even suggest that it was in fact possible to accomplish the objects for which the Hetch Hetchy project is designed at a more economical figure than the records of actual construction costs indicate. Their sole complaint is that estimates have been exceeded. Whether or not it was possible to construct the work within the original estimates in view of unforeseen difficulties in the matter of submarine construction on the Bay Division, and in the handling of unexpected quantities of water in driving the tunnels on the Mountain Division does not seem to concern them, not to speak of labor difficulties fomented by the agitators among the tunnel workers; nor have they apparently made an examination to determine whether these conditions which caused the excess over certain estimates could have been reasonably predicted at the time the estimates were made. As they have not made any investigation of these matters I shall assume in passing that their action is based entirely upon the principle that estimates were in fact exceeded, no matter how justifiable the reasons for the excess, and that therefore the Board of Public Works must be deprived of authority to construct the project except under detailed direction of the Board of Supervisors. This action is taken, notwithstanding the vote of the people in November, 1918, amending article XII, chapter I, section 9, subdivision 8, of the Charter so as to confer 'full authority' in the Board of Public Works to contract for work, materials, services and equipment under ordinances to be enacted by the Board of Supervisors in the construction of public utility projects.

"The ordinance under which we are operating was passed in direct accordance with the mandate of the people as expressed in that Charter amendment, and was designed to accomplish practical, economical and efficient means of carrying on large construction projects. Prior to the enactment of this and preceding enabling ordinances, it was necessary for the Board of Works to submit in advance to the Supervisors an estimate of each piece of work to be done, a description of each piece of equipment to be bought, and a statement of each lot of materials to be purchased for carrying on any work. These estimates were then referred to the proper committee of the Supervisors, discussion was had, the matter was reported back to the Board of Supervisors and in the course of time, with due allowance for occasional intervening holidays, was enacted into an ordinance. After this was done, and not until then, would the Board of Public Works be authorized to enter into the contract or purchase the article of equipment or supplies in question, or hire the necessary men to do the work. Under this system it was found to be absolutely impossible to accomplish any degree of economical performance on a large construction job where almost all parts of the work are interdependent. The delays in acquiring the necessary items of equipment would necessitate holding a number of men on the payroll idly waiting for its arrival or else discharging them and disorganizing a part of the force, with consequent delay and expense in starting up again. Other work would be held up for lack of necessary supplies. Unforeseen emergencies would require the employment of more labor than was contemplated in some detailed authorization, and further delay would be incurred. In addition to all this, the Supreme Court held in effect in the Crowe-Boyle case that the procedure in letting contracts might be prescribed by the Supervisors and it was found that a saving of many thousands of dollars could be made by eliminating in the contracting procedure the requirement for holding back unduly large percentages of contract price pending final

completion, and the requirement for unduly large labor and material bonds, both of which requirements were embodied in the ordinary Charter procedure for contracts, and had been found in practice very burdensome and unnecessary when applied to construction contracts running into several millions of dollars. The ordinance under which we are working corrected all of these existing difficulties and has enabled work to be carried on during the last four years in an economical and efficient manner. To repeal this ordinance can only have one effect—that is to reduce the whole construction system to the chaos which formerly existed and by reason of the ensuing delays greatly increase the cost of the work which remains to be done. This is the direct opposite of the object which your Committee desires to accomplish.

"If the Board of Supervisors wishes to place a limitation on expenditures which shall be made by the Board of Public Works for any given piece of work, it would be a very simple thing to pass a resolution embodying the cost limit which your Board desires to have placed on the particular item or items involved and prohibiting the Board of Works from incurring any obligations in excess of those limits without further authorization. Any such directions from your Honorable Board will be scrupulously observed and would have been observed at any time in the past had such a resolution been passed. I would have you feel that I have been duly appreciative of the confidence which you have reposed in me and in the Board of Works in giving us practically unrestricted authority to carry out the project. The present financial situation has not arisen from any violation of that confidence on my part. It has been rather due to my understanding that all of the proceeds of the 1910 bond issue could be utilized in the construction of the project, whether those proceeds were in the form of immediate cash on hand or form of bookkeeping transfers to the operating fund or in the form of salvage value of equipment. Every estimate I have made has allowed for the salvage value of equipment purchased by the City and used on the work estimated. If your Committee refuses to take this salvage value into account, of course the estimate should be increased accordingly. In all my computations as to the adequacy of the 1910 bond fund to cover the completion of the Mountain Division, I have assumed that money paid out of that fund to a contractor and paid back to the City by the contractor in the form of compensation for freighting materials and supplies into his work would remain available for construction purposes, or at least for the partial payment of the operating costs of the Hetch Hetchy Railroad which carried the freight in question. This assumption was based not only on sound construction accounting but upon the provisions of section 16 of article XII of the Charter, which fixes the operating expenses as the first charge against utility revenue. If, notwithstanding these assumptions and these provisions of the Charter, your Committee believes that no part of this operating fund should be used for paying the operating expenses of either the Hetch Hetchy Railroad or the Early Intake power house, obviously that fact will throw all of my assumptions and computations out of gear. The fact remains that your Board has not heretofore instructed me by resolution or ordinance that salvage value of equipment could not be considered or so-called operative revenue used for even the payment of operating expenses of the portions of the project which earned the fund. Under such circumstances I do not accept and do not think that I merit the criticism which the Chairman of your Finance Committee has directed at me.

"Whether you agree with me in this explanation or not, it seems plain that the objects which your Committee seeks to accomplish will not be accomplished through the repeal of the enabling ordinance, and I earnestly hope that you will give the matter your careful consideration before taking a step which can only operate to cause delay and increased expense in completing the work on the Mountain Division and Bay Division of the project.

"Very respectfully,

(Signed) "M. M. O'SHAUGHNESSY,
"City Engineer."

CHIEF O'SHAUGHNESSY: In addition to that, I may say that in 1918, upon the commencement of operation of our railway and the commencement of the operation of our power house, funds from earnings came in to our treasury, and a special bookkeeping account was established under order of the Board of Supervisors. Now, the funds from the sale of power are a net profit, as we are using, say, 5 per cent of the power for construction and selling the difference. Now, that excess power sale to the outside company was a net profit to the project.

Our railway earnings are an entirely different proposition. Take the construction of the Hetch Hetchy Dam. The contractors, in hauling the materials for that dam, possibly paid $800,000 in freight bills, $8 a ton for hauling materials and cement up from Hetch Hetchy Junction over 68 miles of rail line to Hetch Hetchy. All that money, through a bookkeeping arrangement, was turned into this so-called operating fund, and the $700,000 expense that the City made in hiring brakemen and trainmen, and buying fuel oil and keeping up the track was all taken out of our Hetch Hetchy construction bond funds and has never been restored, so that the project funds were practically deprived of this amount. And I know that section 16, article XII, of the Charter says distinctly that the earnings of a public utility must first go to pay the expenses for operation, and then any balance funds left may be used for other purposes in the discretion of the Board of Supervisors.

Now, in connection therewith, I wrote on September 28, 1923, to the Honorable Board of Public Works, the following letter:

"September 28, 1923.

"Honorable Board of Public Works,
City and County of San Francisco,
City Hall.

"Gentlemen: On February 27, 1923, I wrote your Board as follows:

" 'I am advised by a statement from the bookkeeper's office, that on December 31, 1922, there was a balance in the Hetch Hetchy operative fund of $652,868 in cash, that the operating expenses of the Hetch Hetchy Railroad have been paid out of the proceeds of the water bond moneys to date, and total $1,482,000. Under the provisions of section 16, article XII, of the Charter, the Supervisors are required from time to time to make appropriations from the receipts of public utilities, to cover, first, the operating expenses of such utility; second, repairs and construction. As the operating expense of this utility exceeded the total balance in the operating fund on December 31, 1922, I am of the opinion and recommend that the Board of Supervisors should be asked to pass a resolution appropriating this balance in the operative revenue fund as a credit against the operating expenses of the Hetch Hetchy Railroad so as to minimize the loss from its operations. The necessity for this appropriation will become clearer if it is remembered that, under the contract with the Utah Construction Company, the contractor is charged freight for all of the cement and other materials hauled over the railroad. It is to be presumed, of course, that the contractor has estimated charges of this freight in fixing its contract price for the construction of the Hetch Hetchy Dam. The net result of this situation is that the proceeds of the water bonds have been used to pay the operating expenses of the Hetch Hetchy Railroad, although a portion of them appear as a credit to the revenue fund of the railroad, by reason of the fact that this portion was paid the contractor as part of the contract price, and then paid by the contractor to the City for freight charges. This is perfectly correct as a matter of bookkeeping, and correct cost accounting, but it does not mean that the Hetch Hetchy Railroad has earned in outside revenue $652,000, or any similar sum. And it is quite clear that this apparent balance should be returned to the water bond fund as a credit to the operating expense on the railroad. The money thus returned to the fund can thus be used for further construction purposes. I heartily recommend that you request the Board of Supervisors to appropriate the sum of $652,000 shown to be the balance in the operating fund, as of December 31, 1922,

toward the payment of operating expenses of the Hetch Hetchy Railroad incurred prior to that date.' "

On February 28, 1923, your Board of Public Works adopted resolution No. 76571, New Series:

"Resolved, that this Board recommend to the Board of Supervisors the adoption of the subjoined draft of a resolution, by which the sum of $652,000, representing the cash balance of the operating revenue fund of the Hetch Hetchy project, as of December 31, 1922, will be appropriated toward the operating expenses of the Hetch Hetchy Railroad, incurred prior to said date, the Treasurer to be authorized and directed to make the necessary transfer as specified."

Up to the present, the Finance Committee of the Board of Supervisors have taken no favorable action on the recommendation of the City Engineer and the Board of Public Works, and I recommend that your Board, by resolution, again request the Board of Supervisors to make the transfer as heretofore recommended. And here is a resolution prepared by the Board of Public Works, for the Board of Supervisors, which was filed with the Board and with the Finance Committee:

"Resolved, that this Board reiterate its request of March 21, 1923, for the adoption of a drafted resolution, by which the sum of $652,868, representing the cash balance in the operating revenue fund of the Hetch Hetchy project as of December 31, 1922, would be appropriated toward the payment of the operating expenses of the Hetch Hetchy Railroad, incurred prior to said date, the Treasurer to be authorized and directed to make the necessary transfer as specified. Further, that additional copies of the draft of the hereafter mentioned resolution be and they are hereby transmitted to the Board of Supervisors for adoption.

"Adopted September 28, 1923. Commissioners Fraser, Reardon, Stanton."

Now, I want to say that the City Engineer's office stands on the Charter provisions that say that the operating expenses of the railroad must first be paid out of the earnings, and I think, in all conscience—and I do not believe Mr. McLeran intends to do anything improper—but I think any other treatment is not right. I think that money earned by the railroad should be turned back into the railroad to meet operating expenses. The money earned by the power, you are at liberty to do anything you please with—that is yours, but I think this other money belongs to the railroad, should be re-transferred to our fund, and let us complete the project.

Gentlemen, I thank you for your courtesy in giving me this hearing.

The plain object of this diversion of Hetch Hetchy operative funds was to lower the tax rate, with the view of making good election material to render incumbent Supervisors more eligible for re-election as Supervisor.

This diversion of the earnings of the utility toward paying for bond interest is highly improper, as the Charter prescribes that all bond interest must be paid by direct taxation.

Another matter of controversy was over the change of plans for building the Dumbarton Bridge to carry our transbay pipe line from the subaqueous pipe under the navigating channel 3800 feet long by means of a steel bridge on concrete piers. Like all parts of the Hetch Hetchy project, this was designed to economically take care of future expansions. The present bridge carries one pipe five feet in diameter. The bridge is designed so that a parallel future pipe 10 feet in diameter may be laid, without increasing either the size or cost of the project. This method of construction had the approval of

the Finance Committee and the Public Utilities Committee and the whole Board of Supervisors with whom I conferred two years previously, when I fully explained the matter to them, and the extra cost of this type of amended structure was approved, was beyond the cost of that initially proposed cheaper structure on wooden piling, subject to teredo attack. On October 16, 1924, I took Supervisor McLeran down to see this proposed bridge, which was estimated to cost $600,000 more than the initial estimate, and made this memorandum at noon on my return to San Francisco with Mr. Eckart, my assistant, on October 16, 1924, "McLeran O. K. for $600,000." This memorandum I gave Mr. Eckart after visiting the bridge at Dumbarton with Supervisor McLeran, showing him the magnitude and type of the work. He was Chairman of the Finance Committee and hitherto had not shown interest enough to even visit any part of the Hetch Hetchy project work in the five years subsequent to June, 1919, and yet he was O.K.'ing our bills and supervising our work, while he knew nothing whatever about the character and magnitude of the work being done. Here is a statement made by him to the Board of Supervisors on the 20th of October, 1924, over the same bridge:

> I have asked the City Engineer what it would cost to build a bridge so that it would accommodate motor vehicle traffic. It is built strong enough to carry ten times the load it is carrying and built that way in order to resist the tides that run very fast, and it runs very fast in this particular district. It was a wise thing the Board did when we authorized the additional expenditure of money to change the bridge from wooden piles to concrete. (December, 1923.) Notwithstanding the fact that the Southern Pacific bridge had been there for more than 20 years, they are now reconstructing it. The tide waters have worn the piles out and the Southern Pacific Company is spending about $300,000 there now. I think that eventually they will have to tear out their bridge and build the same kind of a bridge that we have built.
>
> By putting a few brackets on either side of our bridge that we have there now, at a small expenditure, the people can cross the small end of the bay over the structure that we have built.

During the debate by the Supervisors, Mr. Angelo J. Rossi, colleague of Mr. McLeran on the Finance Committee, stated in arguing for a repeal of Mr. McLeran's stop-work order that "the Acting Mayor is in a very embarrassing position. We all make mistakes. He made one and should be big enough to admit it."

Rossi maintained there was money enough on hand to prosecute Hetch Hetchy work and it should be continued. He thought McLeran had an ulterior motive for his action and this motive would come out eventually.

The injunction against this stop order was heard before Superior Judge Walter Perry Johnson, who decided against the Acting Mayor, using some of the following expressions:

> I do not regard the order of the Acting Mayor as having any binding force on the Board of Public Works.
>
> The order amounts in law to nothing more than a recommendation given in an advisory capacity as to the course which in the judgment of the Acting Mayor should be pursued under the circumstances. The Board may, notwithstanding, exercise its own independent judgment as to the manner in which the work shall be done.

This ruling was made by Superior Judge Johnson on December 6, 1924, which finished the controversy so far as McLeran was concerned.

The previous statements show that Mr. McLeran was thoroughly defeated in his schemes for blocking the work, as indicated by the decision of Judge Johnson in repudiating his order and on the approval of his colleagues on the Board to permit work to proceed.

The most interesting comment on the controversy is from a San Mateo paper:

HETCH HETCHY POLITICS

(*San Mateo, Cal., News Leader,* November 28, 1924)

It will all come out in the wash—that is, if there is to be a thorough washing and not a whitewashing in connection with the dispute over the construction at Hetch Hetchy.

Acting Mayor McLeran has many qualifications and apparently is perfectly sincere in his efforts to safeguard the taxpayers' interests, but he is also a politician, and though a contractor, is not an engineer, certainly not one to go up against a man like O'Shaughnessy in such a controversy.

Nothing thus far revealed justifies any question as to either the capacity or the integrity of City Engineer O'Shaughnessy.

He has acquired and deserved not only a national but an international reputation as one of the foremost engineers of the time.

Those best qualified to judge the difficulties he has overcome are most eloquent in praise of his work.

Time and again he has given warning disregarded by the politicians, but subsequently justified by the results.

It is one thing for a contractor to give fairly accurate estimates of the cost of building a house or a store in districts where there are other houses and stores, and quite another for an engineer to anticipate all the troubles likely to be encountered in heavy construction in new territory. There is no telling where unexpected rock may be encountered, nor where it is likely to give out, thereby necessitating the digging down to a very low level to get the required foundation.

O'Shaughnessy is an engineer and not a politician. He may not be tactful, but he is capable, and it remains for the politicians to show wherein he has been at fault as an engineer. People should not be in a hurry to condemn him on the strength of figures compiled by his political enemies.

The following article was written for *The Argonaut* of June 29, 1934:

SAN FRANCISCO'S HETCH HETCHY WATER PROJECT

By M. M. O'Shaughnessy, *Consulting Engineer, Public Utilities Commission*

It is expected that the pure water from the Tuolumne River watershed will be flowing to San Francisco through the Hetch Hetchy Aqueduct in September of this year. This 150-mile aqueduct from O'Shaughnessy Dam in Yosemite National Park to Crystal Springs Reservoir in San Mateo County will be ready for service upon the completion of placing concrete lining in two miles of tunnel near Livermore.

The Hetch Hetchy project, planned to bring to San Francisco sufficient water for a population of four million persons, was first conceived in 1901 under the administration of Mayor Phelan. At that time, members of the City Engineer's office filed appropriations of the waters of Tuolumne

River and certain tributaries under the California laws. Due to the fact that Hetch Hetchy and Lake Eleanor reservoirs both lie within Yosemite National Park, the City's application for permission to build dams at these locations was denied by the Secretary of the Interior and it was not until December, 1913, that the necessary permission was granted by an act of Congress known as the Raker Act.

In the meantime two bond issues for the water construction had been authorized by the voters, by tremendous majorities. One of these, for $600,000, was used to buy lands and water rights. The other, for $45,000,000, was planned to build works to bring to the City 60,000,000 gallons of water daily by pumping over Altamont Pass.

During the fight before Congress the City presented the "Freeman Plan" of development, planned to deliver ultimately 400,000,000 gallons daily by gravity and to develop 250,000 horsepower of hydro-electric energy by using the fall of the water in its course from the high mountain region to the low seaboard level.

No water can be obtained outside of the City anywhere without a controversy. The Spring Valley Water Company had a contest with San Mateo citizens before being permitted to build Crystal Springs Dam. The City has continuous contests with the irrigationists of Turlock and Modesto below the Hetch Hetchy for its rights to convey water. There is a case now under adjudication by Judge Tuttle, of Nevada County, which may clear the atmosphere considerably. The only final solution of water supplies for reservoirs in California is the construction of large dams on the high levels of the mountains. The Tuolumne fluctuates between 600,000 acre-feet in a dry year and 5,000,000 acre-feet in a very wet year. The result is, in the very wet years the water from the watershed flows into the bay and does nobody any good. Mutual agreement to build those large dams is a basic solution of the problem and the evidence shows there will be ample water in the Tuolumne River for both the needs of the irrigation districts and the growing demands of San Francisco.

The Raker Act required the immediate construction of the structures in the mountains, but prohibited the delivery of water into San Francisco until the local supplies had been exhausted. Consequently, the construction schedule adopted was to build (1) O'Shaughnessy Dam, (2) the mountain tunnels, and (3) Moccasin power plant, and then to continue the aqueduct construction on the most economical time schedule with the aim to bring the water to the City by the time that the local sources of the Spring Valley Water Company should have become insufficient, which was estimated at 1933.

After ratification of the act by the City, construction began. Due to the extreme roughness and inaccessibility of the country, much preliminary construction was necessary. Among other things, the City built a 68-mile standard gauge railway. In 1918 a construction power plant had been completed and put in operation. In 1925 the Moccasin power plant went into operation, since which date it has brought the City a total revenue of $18,500,000. The construction power plant has produced a total revenue of $1,300,000.

From Moccasin the aqueduct extends westerly as a 16-mile tunnel through the Sierra foothills. The driving of this tunnel was completed in 1928. At Red Mountain Bar, five miles from Moccasin, the aqueduct crosses the canyon of Tuolumne River as a steel pipe 9½ feet in diameter. Here the waste water not required for San Francisco's use is discharged back into the river. Utilization of the drop of this waste water through a proposed power house to cost $1,000,000 would bring the City a revenue of $500,000 annually.

In constructing the foothill tunnels, about half of the work was let by contract and the remainder was done by direct day labor employees under the direction of the writer as City Engineer. Under exactly comparable conditions the day labor crews drove tunnel for $35.53 per foot as against $40.49 by contractors' forces, and placed concrete lining for $36.11 per foot as against $47.38 by contractors' forces.

From the end of the foothill tunnel a pipe line 47½ miles in length extends across the San Joaquin Valley to the beginning of the Coast Range tunnel. The latter, 28½ miles long, has been a very difficult piece of construction. Opponents of the project predicted that it could not be completed. It is not only the longest tunnel that man has ever attempted, but it traverses ground of such a nature as to call for the greatest engineering skill and indomitable energy and perseverance.

The new Charter of the City and County of San Francisco in effect January 8, 1932, requires that the construction of public works involving the expenditure of more than $1,000 be done by contract. Another provision allows "appropriate departments" to bid on such contracts. The Public Utilities Commission on June 6, 1932, opened bids for the completion of construction of the Coast Range tunnel. Besides bids for portions of the work there were three bids for the entire job. The lowest bid was that of the Hetch Hetchy Project, which had so far been carrying on the construction on a day labor basis. This bid of $5,257,665, which was $557,670 lower than the next lowest contractor's bid, was based on the Department's experience as developed during the progress of the work here and in the foothill tunnels. The bid was thoroughly investigated by the Controller and approved, and on July 25, 1932, the Public Utilities Commission awarded the contract to Hetch Hetchy Project. Work began under the contract on August 15, 1932. Operations have been carried on economically and efficiently and as of May 1, 1934, work valued at the low bid prices at $4,811,656.64 had been done at an expenditure of $4,224,743.12.

The Coast Range tunnel, which is 10½ feet in diameter of finished concrete, extends from Tesla Portal near Tracy to Irvington Portal near Mission San Jose. The first unit, 25 miles in length, emerges at Alameda Creek, three miles south of Sunol. A concrete and steel pipe line 3000 feet long extends across the valley and connects with the second unit of tunnel which is 3½ miles long. To facilitate construction of the 25-mile section, five shafts were sunk from the surface down to the tunnel level and tunnel was driven both east and west from each shaft. The longest unit of tunnel (5¼ miles) is that from Mocho shaft to Mitchell shaft, which is just being completed. Both of these shafts are more than 800 feet deep.

The entire length of tunnel deviates slightly from a straight line, as several angles were introduced to avoid the most unfavorable geological formations and at the same time to keep the shafts to practicable depths. The geologists tell us that the reasons for the ground being so difficult to tunnel are that the strata have been squeezed and contorted at a relatively recent date, geologically speaking, and that the constituent minerals of the original rocks have been chemically altered by heat and pressure to recrystallize as chlorites and other objectionable minerals which under certain conditions cause swelling, squeezing and excessive pressure.

To keep the bore open during construction, the ordinary 8x8-inch timber sets at 5-feet center to center were increased to as great as 16x24-inch timber at 2½-foot centers. In places, even these were not strong enough and were replaced or else reinforced by rings of gunite concrete up to three feet thick. In places the ground would squeeze so quickly that ordinary cement in the gunite would not have time to set and develop its full strength. In such cases the 24-hour, or quick-setting cement, was used. The most extreme case was in the last tunnel holed through, where the ground swelled so fast that, January 5, 1934, it was necessary to leave an air space of one foot outside the gunite, into which the ground might swell while the cement was setting. This method was perfectly successful. In no place has the final concrete lining been ruptured.

Quicksand was encountered a few times. In one case this caused a rush of sand and water which completely filled the tunnel. After the water had drained from it the sand was removed and the tunnel completed.

A dangerous gas called methane was encountered at a number of points. This gas is the principal constituent of the natural gas used for cooking and heating purposes and its presence in certain proportions in the air makes a highly explosive mixture. Notwithstanding extremely rigid safety

precautions, an explosion of methane in July, 1930, killed twelve men. Many investigations failed to find the direct cause of the explosion. The City was exonerated from all blame. Additional safety measures subsequently put into effect have retarded the work and increased its cost. At that time "permissible" electric storage battery locomotives replaced the ordinary battery locomotives. It affords an interesting comparison with methods used in 1898 in working the old Tesla coal mines, near our tunnel. I have a photograph of these mines showing an electric *trolley* locomotive used in tramming coal trains and presenting a constant menace from sparks in an explosive atmosphere.

It is with pleasure that I commend the ability, zeal and loyalty of the men who have pushed to completion this tremendously difficult construction.

Following the Coast Range tunnel are the bay crossing pipe line, 21 miles in length, and the Pulgas tunnel, 1¾ miles long, which discharges into Crystal Springs Reservoir. These have been in service since 1926 bringing water from the Alameda Creek sources of the old Spring Valley Water Company system. When the bay crossing pipe line was constructed, provision was made for a future parallel pipe. Under the NRA bond program approved at the November, 1933, election, bids have been received for construction of this second pipe line and work will begin at an early date.

The confidence of the people in the Hetch Hetchy project is shown in their support of the various bond issues.

	Vote			*Bonds*
Year	*For*	*Against*	*Amount Authorized*	*Outstanding June 30, 1933*
1909	34,572	5,641	$ 600,000	none
1910	32,888	1,609	45,000,000	$32,000,000
1925	68,549	3,361	10,000,000	9,000,000
1928	94,859	11,381	24,000,000	24,000,000
1932	128,691	9,373	6,500,000	5,477,000
Total issues			$86,100,000	$70,477,000

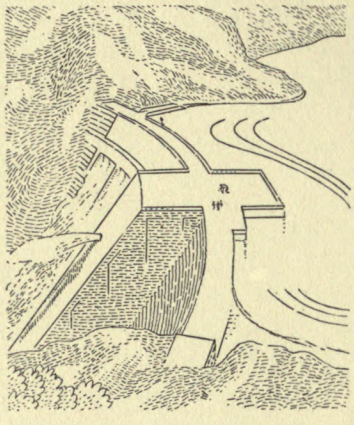
There have been times when municipal bonds have been difficult to sell, as the Charter has always prohibited their sale at less than par. This condition obtained in 1930-31 when the Treasurer had bonds to sell but no buyers. Cash funds were low and the work was about to shut down when the Hetch Hetchy employees presented a plan that saved the day. Every employee from highest to lowest contributed 10 per cent from the gross amount of his monthly pay to create a fund to pay discount on bonds sold. At each payday, bonds were purchased by investment houses at par and sold at the market price, the difference being paid out of the fund provided by the employees' contributions. Thus the employees did what the City could not do and saved the City the immense amount that would have been lost if the work had stopped.

The financial showing of Hetch Hetchy to date is:

Coin expended by the City	$75,000,000.00
Interest paid by taxpayers	10,500,000.00
Total cost	$85,500,000.00
Credit one-half dividends to date—sale of power	9,784,154.82
Net cost of water project	$75,715,845.18

This is a large undertaking for a small city the size of San Francisco. "The City That Knows How" with courage and determination has brought the project to completion and I am extremely proud to have been associated with the work so long.

I am also extremely proud of the cost of the work, considering that an Eastern project—the Ashokan supply of the city of New York, which is a much shorter distance away (only 120 miles)—has cost to date $180,000,000 in coin. In other words, for one-third the outlay, we have accomplished the same undertaking, which is a credit to California engineers and constructors.



Hetch Hetchy—*Its Origin and History, by* M. M. O'Shaughnessy, *Consulting Engineer*, San Francisco. Of this first edition, one thousand copies were printed by The Recorder Printing and Publishing Company, San Francisco, California, October, 1934.